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SCIENCE

12 August 1955

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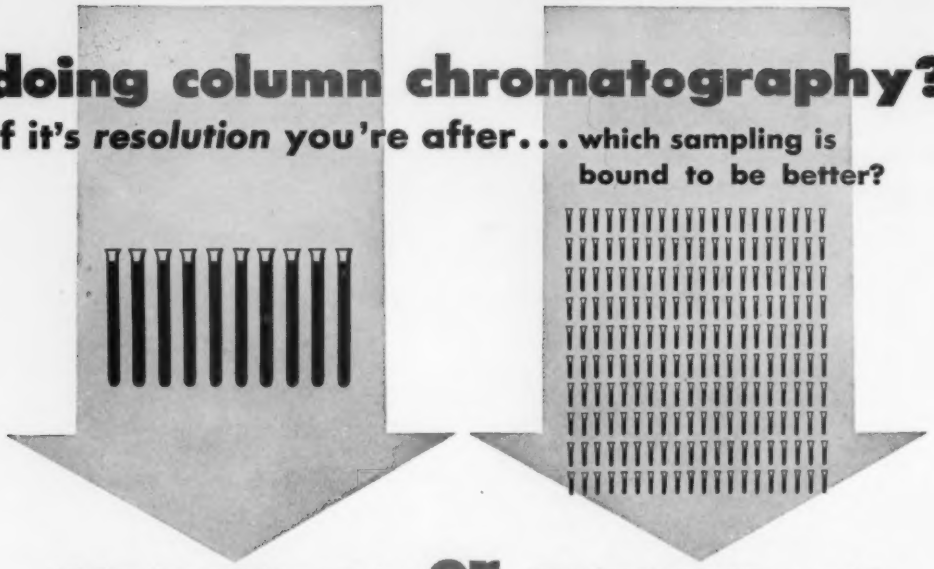

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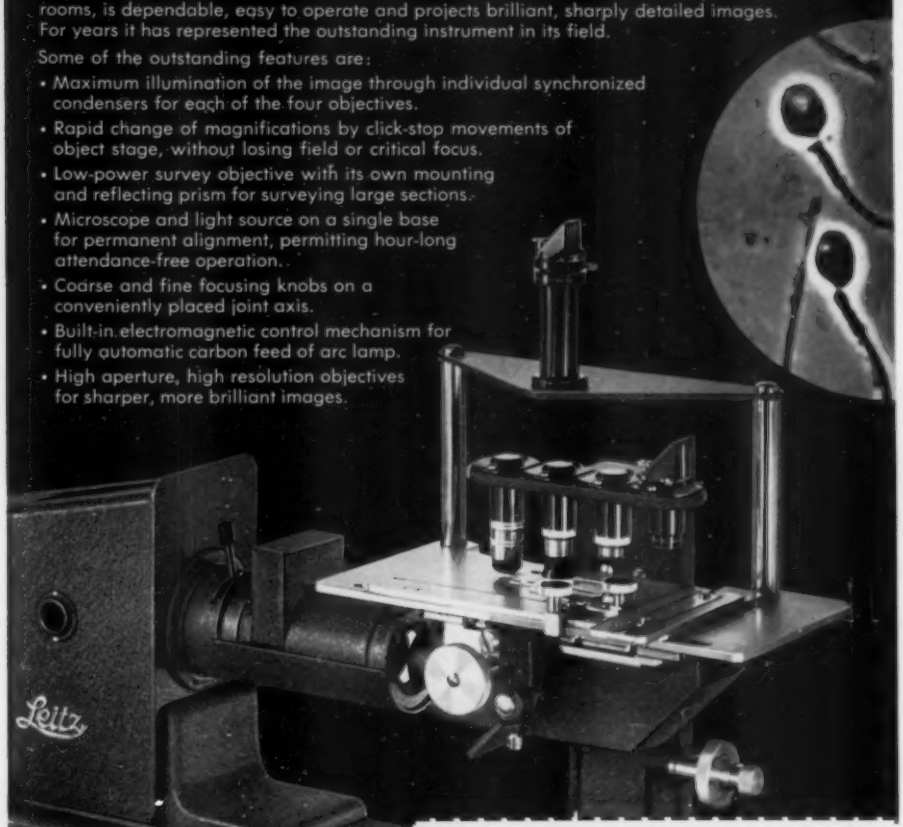

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ADVANCES IN EXPERIMENTAL CARIES RESEARCH

Edited by: Reidar F. Sognnaes, Harvard School of Dental Medicine

6 x 9 inches, 246 pages, 49 illustrations, index, clothbound, 1955

Price $6.75. AAAS Members' prepaid order price $5.75.

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This is the first monograph devoted specifically to the information gained from research on the experimental production and prevention of tooth decay in laboratory animals. Twenty distinguished investigators, representing not only dentistry but also the basic sciences of anatomy, pathology, zoology, biochemistry, nutrition and bacteriology, report and review pertinent experimental work. The book has been unusually well organized to represent a coherent sequence rather than a series of isolated papers, and the whole is summarized skillfully by the Editor in a final chapter, followed by a very detailed subject and author index.

The importance and universality of the caries problem hardly need emphasis. Since clinical trials on humans are time consuming, costly and complicated, this animal work offers a most promising approach. Research reported here is encouraging in two respects. More precise knowledge has been gained regarding the long-suspected relationship between the oral environment and the production and prevention of tooth decay, and new light has been shed on various systemic factors contributing to the development of caries-resistant teeth. The volume will suggest many further lines of research toward an ultimate solution of the problem.

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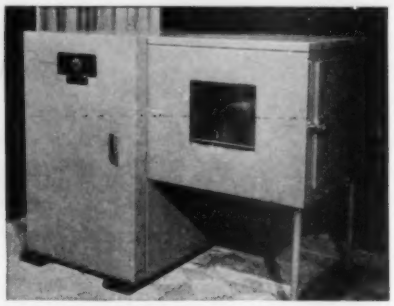

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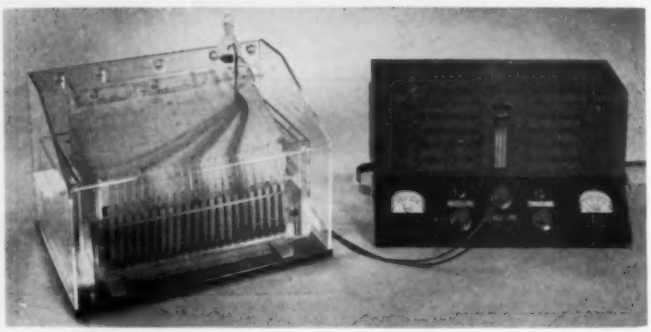

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Publicity: The Scientists' Responsibility

Only a few years ago scientists had frequent justification for the complaint that many newspaper and magazine accounts of their work were sensational and distorted. Each of us probably has his own personal example. My first break into the popular press followed a meeting at which I reported a study in which white rats were used. In a newspaper story in which the closest approach to accuracy was the misspelling of my name, I was credited with the advice that turning white rats loose in a house would rid the premises of wild ones.

Mistakes still occur, and the sensational is sometimes more likely to be published than the sober. But the past 20 years have seen great improvements in the popular reporting of scientific work. The National Association of Science Writers has been a powerful force in this direction, and as science reporting has improved, scientists have become more willing to work cooperatively with press representatives in seeing that their work is accurately and informatively reported to the interested public.

Now a new difficulty is growing, and a new criticism. Where scientists used to be reluctant to talk to reporters, some now seem too eager. One of the best papers presented at the 1954 AAAS meeting was also one of the most severely criticized on the score that the author's press-room abstract claimed too much credit and originality. The results of the Salk vaccine studies were released in what was probably the largest scientific press conference ever held. Granting the great public interest and the unusual circumstances, the magazine *Newsweek* still described the event as having a "circus atmosphere," an atmosphere made doubly unfortunate by the disappointment and confusion that quickly followed.

More recently, a columnist in the *New York Times* has criticized the televised *March of Medicine* program for going beyond the bounds of discretion and providing additional justification for the previously heard criticism that televised medical programs have sometimes shown a tendency toward sensationalism.

Several years ago a book on sexual behavior was released to the press before it became available to anyone else. The book had good publicity value, and stories about it probably helped to sell thousands of extra copies of newspapers and magazines. But some of the reporters who wrote those stories were critical, on the excellent grounds that scientific work should first be subject to the critical appraisal of other scientists.

Professional science writers want their reports to be accurate. Facts are checked, reference sources are used, different points of view are examined, and frequently several different scientists are consulted on a single story. As a result there has been much excellent popular reporting of scientific work. But there are also deadlines to be met, and no reporter wants to be scooped on what looks like an exciting story. Inaccurate and exaggerated reports thus sometimes get published. But the reporter is not wholly at fault; he is at the mercy of the scientist whose story he is telling. If the original report is obscure, or is treated in a sensational manner, or claims too much originality, the primary blame for an inaccurate story falls on the scientist. He may get wide publicity the next day, but he has done a disservice to his newspaper friends, his colleagues, and his science.—D.W.

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12 August 1955, Volume 122, Number 3163 SCIENCE

Present Status of Cancer Tests

Douglas H. Sprunt, William M. Hale, Frederic C. Chang, Sara G. Richmond, Cyrus C. Erickson

Since the onset of cancer occurs without perceptible symptoms and since it can be cured in its early stages, there have been many who have sought methods for early detection of this disease, particularly a method of screening that could be used quickly and inexpensively as a case-finding method. These methods may be roughly divided into three groups: (i) the measurement of some product of the cancer; (ii) the measurement of some change in the body resulting from the cancer; and (iii) the measurement of some change in the body that favors the development of a cancer.

In examining, in the literature, the claims for cancer tests, one should always keep in mind the type of patients used in the evaluation. After a cancer is well developed, many changes occur in the host that are not necessarily concerned with cancer but are the result of chronic disease. For example, it was shown by one of us (*1*) several years ago that the sedimentation rate test was positive in 69 percent of all well-developed cancers, whereas it was positive in only 48 percent of early, localized cancers. In an evaluation of a cancer test it is expedient to know whether the test is to be used as a method for finding cases of cancers or whether it is just an adjunct to other diagnostic methods.

In this paper (*2*) we discuss cancer tests from the standpoint of a case-finding method only. It is quite possible that a test not useful as a screen would be useful as a diagnostic aid. Dunn and Greenhouse (*3*) have set up excellent criteria that are important to follow in the evaluation of a cancer test. These authors showed that a test in order to be of value must be positive in 90 percent of *early, localized* cancer and that there should be only 5 percent false positives.

Many workers in recent years in their evaluation of a cancer test have overlooked Dunn and Greenhouse's statement that the cancer test should be 90-percent positive in early, localized disease. Cancer tests too frequently have been evaluated on hospital patients whose disease, although still localized, was fairly extensive. A test may be positive in a high percentage of these, not for reasons primarily associated with cancer, but for reasons that may be absent in early cases. Dunn and Greenhouse (*3*) considered the 5 percent false positives permissible. It does not make too much difference whether a cancer test is positive in other well-defined diseases such as tuberculosis or cirrhosis. It is unlikely that these diseases will be found, at least in any numbers, in a case-finding survey of the general population. However, for the test that is to be used as a cancer case-finding method on the general population, it does make considerable difference whether the test is positive for minor conditions that are likely to be found in fairly high numbers in the general population.

We have found that a good method for the evaluation of a cancer test is to take for study all the patients who come to a cancer clinic with skin and breast lesions and with suspicious cervical changes. In this way we obtain a large number of patients with early and localized cancer. Blood is taken on all these patients, and the tests to be evaluated are run in duplicate. We have recently tried this method on three tests. The first is the Penn test, which was first described by Penn and his group in 1952 (*4*) and which they have modified on several occasions. Some of us have had the privilege of working with Penn and his associates with this test. The reaction is a very interesting one and gives a high percentage of positive tests in the serums of patients with moderately advanced cancer; the one exception is that in cancer of the breast the reaction is frequently negative. The flocculant used in this test is derived from a choladienic ester and was kindly supplied to us by the Lederle Laboratories of the American Cyanamid Co.

The second test used is a modification of the Penn flocculant and was developed by two of us. The chemical nature of this flocculant has been described by us (*5*), and since one difference between this and Penn's flocculant is a chlorine radical, we have called it a chloral flocculant. This flocculant is somewhat more soluble than Penn's, and this may contribute to the higher number of positives we obtained.

The third test is the C-reactive protein antiserums test that was first described in 1930 (*6*). The antiserums were made available to us by Schieffelin and Co. It is a test that is highly specific for inflammation. The results of our evaluation of this test and the two other tests are shown in Table 1. It may be seen from this table that, although the number of cancers that gave positive reactions is quite high, the positives do not reach 90 percent. It may also be noted that, although the percentage of positives obtained with the chloral test is generally higher than that obtained with the Penn test, this advantage is nullified by the fact that the number of positives from patients with noncancerous conditions was also increased. It should be remembered that all the patients in this series were patients with cancer in its earliest stages, and that the cancer diagnosis of all patients listed as having cancer was verified by biopsy.

We were quite interested that the C-reactive protein antiserums test gave results similar to, but not identical with, those obtained with the flocculation tests. Since inflammation is almost always associated with cancer, we took six serums that gave highly positive precipitates with both the Penn flocculant and the

The authors are members of the staff of the Institute of Pathology, University of Tennessee, Memphis.

Table 1. Evaluation of cancer tests

	Penn			Chloral			C-reactive		
	No.	Test positive		No.	Test positive		No.	Test positive	
		(No.)	(%)		(No.)	(%)		(No.)	(%)
Squamous cancer of skin	19	9	47.3	19	13	68.4	18	12	66.6
Basal cancer of skin	13	8	61.5	13	11	84.6	13	11	84.6
Cancer of cervix (invasive)	3	3	100	3	2	66.6	3	3	100
Intraepithelial cancer of cervix	16	7	43.7	16	9	56.2	13	7	53.8
Cancer of breast	6	2	33.3	6	5	83.3	3	3	100
Cancer of other organs	9	5	55.5	9	7	77.7	9	9	100
Noncancerous skin lesions	19	10	52.6	19	12	63.1	18	10	55.5
Noncancerous cervical lesions	26	8	30.7	26	16	61.5	23	13	56.5
Noncancerous breast lesions	6	2	33.3	6	2	33.3	5	3	60
Other noncancers	5	3	60	5	2	40	4	2	50

chloral flocculant and absorbed all the C-reactive protein from the serums with C-reactive protein antiserums. These serums were then negative with both the Penn and chloral flocculants. On this basis we believe that these two tests give positive reactions because of inflammation in the cancer and therefore are negative in the early stages of cancer when inflammation is minimal.

The three flocculation tests described are obviously based on the measurement of changes produced by cancer and other chronic diseases. For some time investigators have been intrigued by the possibility of measuring the changes that are predisposed to the development of cancer. It appears from the work of Dobriner and others (*7*) that hormonal imbalance would be an excellent body change to measure. With this in mind, we have attempted to conjugate a steroid with a protein in order to make an antigenic compound. Although such a conjugation of protein and steroid is possible, the linkages that we have tried so far are quickly broken after they are injected into an animal, and consequently only antibodies to protein are formed.

Although these approaches to the cancer-detection problem have so far been unavailing, the approach that consists of studying products of cancer has been successful. Fishman and Homburger (*8*) have reported considerable success with phosphatase studies on patients with cancer of the prostate. We have had marked success with the use of exfoliative cytology as described by Papanicolaou (*9*) for the early detection of cancer of the cervix. In this laboratory during the past few years we have been making a survey of the women in Memphis and Shelby County by the vaginal smear technique (*10*). It is our plan to study these women three times at yearly intervals.

From the female population of 200,000, we have so far examined 90,000 women once and another 25,000 a second time. The details of this study will be reported elsewhere (*11*). The results, however, show that we have an excellent procedure for finding cases of cancer. Of each 1000 women examined, whether they came from the charity clinics or were women of a higher economic status, we found that 982 could be told that they were all right for another year. Of the 18 in each 1000 whom we were not able to assure that they did not have cancer, 15 consented to have biopsies performed. These biopsies showed four invasive cancers and four intraepithelial cancers; of the remaining seven, two had lesions that were not cancerous but should be followed up, we thought. The remaining five were essentially negative.

We do not wish to classify these 18 in each 1000 as positive reactions; we prefer to consider this technique a cancer screen. As a screen it is very effective, because it eliminates 982 women of each 1000 from the necessity for further study. We are not yet able to say how many of the 982 had cancer that was missed, but preliminary studies of the first 25,000 women that were studied a second time showed that less than two in 1000 had early cancer that had been missed or had developed since the first test. The number of false negatives is so small, the likelihood of their being missed in the second examination is so slight, and the cancer in these is so early that these persons can receive effective treatment when the cancer is detected the second year.

There are two reasons for the success of this program. The first, and by far the most important, is the fact that the test is not thought to be a diagnostic test for cancer but merely a screen for the selection of suspicious cases for further study by biopsy. Since we are not concerned with the biopsy of a false positive test, we are not inhibited from biopsying all suspicious cases. However, even when this is done, 98 percent of the women examined are given a clean bill of health with regard to cancer for at least a year. The second reason is the *esprit de corps* that stems from the size of the program and the technicians' working together. Maintaining this has reduced the human error, which is at a minimum. In fact, there have been several instances in which technicians in the group have done excellent work, but when they moved to an isolated laboratory, the quality of their work suffered.

We have reviewed the status of several cancer tests and have pointed out that false hopes for a test are frequently the result of failure to evaluate the test with early cases. The result is that some condition, such as inflammation associated with moderately advanced cancer, is studied rather than something fundamental to cancer. Consequently early cancers are missed. It is pointed out that the use of the Papanicolaou smear technique in the early phases of cancer is an excellent screening test.

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Abnormal Human Serum Globulins

Frank W. Putnam

Although many diseases induce an elevation in serum proteins, only multiple myeloma and certain related but obscure disorders elicit the formation of pathological serum globulins. These diseases involve a tumor or hyperplasia of the marrow or other branch of the reticuloendothelial system. They are characterized by an increase in the number of plasma cells that are considered a site of antibody synthesis. In a previous study of the nature and biosynthesis of the abnormal proteins in multiple myeloma, we isolated globulins from the individual serums of many patients (*1*). The abnormal globulins have been characterized by their physicochemical constants (*2*) and by their content of *N*-terminal amino acids—that is, by the number and nature of the terminal residues having a free α-amino group (*3*). The biosynthesis of the abnormal globulins has been studied by use of isotopic amino acids (*4*).

It is well known from electrophoretic analysis of multiple myeloma serums that the increase in plasma protein is confined to a predominant component that is remarkably homogeneous when it is compared with normal human globulins (or with the globulin increment in infections or toxic conditions) (*5*). Yet, electrophoretically distinguishable globulins are elaborated by different patients. Most myeloma globulins are of the "gamma" type; that is, their mobility is within the wide range exhibited by normal gamma globulins, and they have a similar molecular weight and shape (*2*). However, the abnormal globulins are more homogeneous in electrophoresis and thus exhibit precisely defined mobilities. With different patients, the mobility of the "gamma" type abnormal globulins may vary from -0.7 to -1.7×10^{-5} $cm^2sec^{-1}v^{-1}$ at *p*H 8.6, compared with a mean of -1.3×10^{-5} $cm^2sec^{-1}v^{-1}$ for the normal gamma globulin. Some myeloma globulins (the "M" or "β" types) have a greater mobility at this *p*H; these are often molecularly heterogeneous and contain several components with unusually high sedimentation constants (*2*). Immunologically, the multiple myeloma globulins fall into two groups of proteins, the members of which are interrelated and cross-react with one another. The one group is closely related to normal gamma globulin, the other (the β type) is distantly related. However, each protein appears immunologically different, indicating individual specificity (*6*). *N*-terminal amino acid analysis has proved effective in the chemical characterization of these proteins and has provided evidence that structurally abnormal forms of serum globulins are synthesized in response to the disease (*3*).

The chemical characterization of pathological serum globulins is best illustrated by reference to the studies on cryoglobulins (that is, serum globulins that gel reversibly on cooling), for these proteins can readily be purified by virtue of their insolubility in the cold. Cryoglobulins occur rarely, even in multiple myeloma, but they have been reported most often in this disease (*7*). They are also occasionally found in an obscure syndrome called cryoglobulinemia. Some of the chief clinical symptoms of the latter disease result from the physical properties of the cryoglobulin—that is, temperature sensitivity of the extremities, high blood viscosity, purpura, and cardiac failure attributed to intravascular deposition of the viscous protein (*7, 8*). The relationship of cryoglobulins to normal plasma components has been difficult to define, because the abnormal proteins have seldom been isolated and described. To be sure, a "cold-insoluble" globulin has been obtained in small amount from normal, pooled human plasma, but its origin has been attributed to contamination with pathological serums (*9*). In the cases we have studied, up to 80 percent of the total plasma protein and up to 98 percent of the globulin are of a kind not detectable in normal human serum.

Because there is no uniformity in the sedimentation constant, isoelectric point, solubility, or other physical properties of the few cryoglobulins thus far characterized, we undertook studies to clarify the relationships of these proteins to one another and to normal globulins. Eight highly purified cryoglobulins have been investigated by physicochemical and *N*-terminal amino acid analysis (*10*). Several were too insoluble at 1°C to permit electrophoretic analysis at *p*H 8.6. However, all were homogeneous at whatever *p*H was suitable for study (*p*H 4.7, 6.7, or 8.6). Although the crystallization of normal serum globulins has never been observed, two of the cryoglobulins crystallized spontaneously in the cold. A summary of the physical and chemical properties of the cryoglobulins and of normal human gamma globulin is given in Table 1.

All of the cryoglobulins differed from the normal protein in two or more of the following properties: crystal form, solubility, isoelectric point, electrophoretic mobility, sedimentation constant, ultracentrifugal or electrophoretic homogeneity, and *N*-terminal amino acid residues. The same properties served to differentiate all the cryoglobulins from one another, with the exception of the first two listed, which appeared similar in all respects tested. These results confirm the physicochemical variability of the cryoglobulins produced by different patients; they establish for the first time that the *N*-terminal residues of these unusual plasma proteins are not identical and, thus, that the molecules are structurally different.

Quantitative end-group analysis by the fluorodinitrobenzene method of Sanger (*11, 12*) has permitted the classification of cryoglobulins into chemically different types. Three of the proteins, which will be referred to as *N*-aspartyl globulins, contained approximately 2 moles of *N*-terminal aspartic acid and were devoid of *N*-terminal glutamic acid or exhibited only traces of this end-group. Thus, in accord with their physical homogeneity they possessed essentially only one type of amino end-group. These proteins had a similar mobility at *p*H 8.6 and a similar S_{20}. The two noncrystalline globulins were tested immunologically and were found to be related to, but not identical with, normal gamma globulin. A second group of three proteins, to be designated as *N*-glutamyl globulins, have approximately 3 moles of *N*-terminal glutamic acid per 160,000 g and little or no *N*-terminal aspartic acid. The *N*-glutamyl globulins differ from the *N*-aspartyl globulins in electrophoretic properties and in ultracentrifugal homogeneity and can also be distinguished from one another by their distribution of sedimenting components. Two cryoglobulins had both aspartic and glutamic acids as *N*-terminal groups but in twice the normal amount. Thus, in the *N*-terminal locus all the cryoglobulins were structurally different from the gamma globulin obtained from pooled normal serum.

Physicochemical and *N*-terminal amino acid analyses have also been com-

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Table 1. Physical properties and *N*-terminal groups of human plasma cryoglobulins.

Protein	Crystal form	*p*I	Mobility at 1°C		$S_{20,w}$	*N*-terminal groups	
			*p*H 8.6	*p*H 4.7		Aspartic acid	Glutamic acid
						(moles/160,000 g)	
			10^{-5} cm²sec⁻¹v⁻¹		S		
Normal γ_2		7.2	−1.3	3.0	6.6	1.12	1.75
Th		7.5	−1.1	3.0	6.6	1.80	0.16
Ag		> 6.4	−1.1		6.6	2.04	Absent
Mi	Needles		−1.3		6.75	2.06	0.16
R	Hexagons		Insoluble	3.0	7.6,* 11	2.00	2.64
Gu			Insoluble	3.3	6.0	2.29	2.21
Se			−0.8		6.4	Absent	2.65
WK		5.5			7, 18,* 28	0.12	3.14
I			Insoluble	3.3	7.6,* 11	0.15	2.77

* Mobilities and sedimentation constants were determined in 0.1 ionic strength Veronal buffer *p*H 8.6 or in 0.1 ionic strength acetate buffer *p*H 4.7. All the cryoglobulins migrated with a single sharp boundary upon electrophoresis. $S_{20,w}$ is extrapolated to infinite dilution except for ultracentrifugally heterogeneous globulins, in which case the major component is indicated by an asterisk. *S* signifies Svedberg units, and *p*I signifies isoelectric point.

pleted on eight myeloma globulins that were not cryoglobulins. In seven cases the distribution of *N*-terminal aspartic and glutamic acids was unlike that found in normal human gamma globulin or in any of its commonly available subfractions. Both *N*-aspartyl and N-glutamyl globulins occurred in this group of proteins. It is of great interest that two of the myeloma globulins proved to be practically devoid of *N*-terminal aspartic and glutamic acids and contained amino end-groups not found in normal globulin fractions (*13*). Both proteins had a molecular weight of 160,000 but migrated with a mobility of only -0.7×10^{-5} cm²sec⁻¹v⁻¹ at *p*H 8.6. One contained 2 moles of *N*-terminal leucine per 160,000 g; the other had about 1 mole of *N*-terminal leucine and about 1 mole of an unidentified *N*-terminal amino acid (or peptide). The unidentified substance behaves like phenylalanine on some paper chromatograms, but it moves faster than any known amino acid in the tertiary amyl alcohol system. Alanine has been identified as one of the *N*-terminal groups in another protein.

We have suggested previously that normal human gamma globulin consists of at least two components, one of which possesses only *N*-terminal aspartic acid, and the other only *N*-terminal glutamic acid (*3*). At first glance, this hypothesis is given some substance by the finding that *N*-aspartyl and *N*-glutamyl globulins predominate in the serum of some patients. It might seem tempting to suggest a correlate of this hypothesis, namely, that patients with multiple myeloma or cryoglobulinemia synthesize one or the other of these or still other normal components excessively and preferentially. However, the present observations demonstrate a far wider variety of amino end-groups and of physical properties than can reasonably be accounted for by such an interpretation. Indeed, we conclude that all the cryoglobulins that we have studied are unnatural proteins in that they are formed only in disease. Alternatively, it may be argued that all these proteins do, in fact, occur physiologically but only in trace amounts.

In this interpretation one is led to the unlikely conclusion that at least seven different types of cryoglobulins occur in normal serum. The *N*-leucyl globulins likewise appear to be abnormal proteins. It is more difficult to decide whether all myeloma globulins are truly abnormal and individually specific proteins, or whether, rather, each results from the profuse and selective synthesis of but one of the many normal globulin components. It is conceivable that an abnormal cell can produce abnormal proteins, but in extensive studies with Steven Schwartz we found no correlation between the morphology of the myeloma plasma cell and the nature of the pathological serum globulin or the proteinuria.

Quantitatively, as well as qualitatively, the change in protein synthesis induced by multiple myeloma is profound. Besides the copious synthesis of abnormal plasma globulins, the profuse excretion of unique urinary proteins (Bence-Jones proteins) is a common characteristic. Neither aberration is invariably present, nor are the two mutually exclusive, yet one or both are always found. Some patients produce twice as much abnormal globulin as a healthy person does total serum proteins, and others excrete as much as one-third of their daily nitrogen intake by way of a protein found only in this disease. In this striking parasitism of nitrogen metabolism may lie a clue both to the mechanism of normal growth and protein synthesis and to the nature of its derangement in disease.

Like the myeloma globulins, the Bence-Jones proteins are of different types (*12*). The urinary proteins have a molecular weight that is one-fourth of the weight of the serum globulins, and they are identified by unusual heat coagulation properties. They are more often excreted if the patient fails to make an abnormal globulin, but for tracer studies we have chosen several subjects in whom the two anomalies in protein synthesis occurred together.

The isotopic studies have as yet failed to reveal any precursor relationships between the abnormal globulins and the Bence-Jones proteins. Contrary to one prevalent view, the results have demonstrated that the urinary proteins are not formed by renal cleavage of the unnatural globulins (*4*). Rather, the Bence-Jones proteins are rapidly synthesized *de novo* from the free amino acids of the body pool and are excreted rapidly. In recent experiments, C^{14} glutamic acid was injected into a patient who had indwelling venous and urethral catheters so that blood and urine specimens could be taken frequently. Radioactive Bence-Jones protein appeared in the bladder within 35 min after injection of the labeled amino acid. The maximum specific activity of urinary protein was attained within 6 hr, and the radioactivity thereafter fell off at a logarithmic rate with a half-time of decline of about 8 hr. Similar results were obtained with another patient who was given C^{14} lysine. Fractionation and isotopic analysis of the blood proteins of these subjects is in progress.

From the physicochemical, chemical, and isotopic studies, the following picture is emerging. Patients with multiple myeloma have a perverted mechanism of protein synthesis. They may make abnormal globulins that are individually specific, whether by the test of immunological or chemical analysis. They may excrete Bence-Jones proteins that likewise appear to be individually characteristic. They may exhibit both aberrations in protein synthesis. No function is known either for the abnormal serum globulins or for the urinary proteins. The abnormal globulins accumulate as if they were made by a defective assembly line that had lost the ability to produce the diverse spectrum of normal globulins. The Bence-Jones proteins are essentially incomplete proteins, both in physicochemical and antigenic features. They are excreted as waste products, perhaps as the unused or unfinished precursors of normal globulins, or perhaps as abortive products of the deranged mechanism of serum protein synthesis. Although normal tissue proteins are not converted directly into Bence-Jones protein, the parasitism of nitrogen metabolism results in a wasting of the patient. The rapidity of synthesis and excretion of the urinary proteins testifies that they

are made directly from metabolites diverted from normal pathways. Further study of the nature and biosynthesis of proteins in multiple myeloma should aid in the elucidation of the mechanism for normal serum protein synthesis.

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Arthur Berridale Keith, Student of Mankind

To live a full and useful life is one of man's most cherished desires. To make major contributions to the study of mankind is given only to the elect. To be humble when showered with honors demonstrates the inner spirit.

In these rare gifts and achievements Sir Arthur Berridale Keith was well endowed. His 88 years were indeed full. Born on Quarry Farm near Aberdeen, his pride in Scotland never left him. His delightful Scotch burr inspired all those who heard his voice. His charm of manner was beguiling.

As a medical student at Marischal College in Aberdeen, human anatomy became his absorbing interest. For dissection, he won a prize. This turned out to be Tylor's *Anthropology*, a book destined to influence his life, for now he commenced the study of mankind—a study that was to nominate him, five decades later, as the greatest living anthropologist.

His first job was as assistant for 2 months in the Murthly asylum near Perth with the special assignment of studying insanity, entertaining the deranged patients, and dissecting the scores of brains in the post-mortem room.

His next job was as assistant to a general practitioner in England. Then came the first real break. Keith was offered and accepted the position of medical officer to a British gold company in Siam, where he remained for 2 years. His first scientific publication resulted from the dissection of 32 Primates. Home in London, his main goal was "to pursue my studies into the origin and antiquity of mankind."

For 5 years he worked in the London Hospital, then became conservator of the Museum of the Royal College of Surgeons of England from 1908 to 1914. The next quarter-century was employed in research on the endocrine glands but more particularly on the physical characters of ancient man.

Keith's contributions to knowledge were recognized publicly in 1921 when King George V bestowed the title of Sir Arthur, the name by which he was known to his countless admirers and student friends. Honors and distinctions rained freely upon Sir Arthur.

Honorary degrees accoladed his writings and his lectures. Election as rector of Aberdeen University in 1930 was a crowning climax to his career. Three years later Sir Arthur became master of Buckston Browne Farm near Downe in Kent, a research center administered by the Royal College of Surgeons; he held this position until his death on 7 January 1954.

The last time I saw him was in 1950. On this cold British summer's day we sat together in his study beside a glowing fire. Sir Arthur listened to the results obtained by the Peabody Museum-Harvard expedition to the Near East in search of new data on ancient and modern man. His questions were clear, his comments encouraging. For 30 years he had guided my researches in this area.

My last impression was of a tall, spare figure enveloped in an old Scotch tweed cape leaning on a long stick as the rain beat down on his tasseled tam-o-shanter with the silver buckle. A radiant smile came over his thin, ascetic face. The rain and mist soon hid him from view.

To attempt to sum up a great man's life in a few words is a hopeless task; to reveal qualities of the inner man is even more difficult. Sir Arthur was soft-spoken, often with hesitant speech as his brain outran his words, kindly to those who sought guidance, swift and sharp to his critics, and above all generous with his time to those who needed encouragement; he well remembered his early days.

His many students, and in these I include all those who learned from his great knowledge, are forever linked together in a common bond by gratitude to their teacher, Sir Arthur Keith. Mankind is the richer for his living, the poorer for his passing.

HENRY FIELD

Coconut Grove, Florida

To do hard things without show of effort, that is the triumph of strength and skill.—A. J. Rowland.

News of Science

Genetic Recombination in Bacteria

A remarkable observation bearing on the mechanism of genetic recombination in bacteria has been published by E. L. Wollman and F. Jacob [*Compt. rend. acad. sci.* **240**, 2449 (1955)]. It had been demonstrated by Lederberg, by Cavalli, and by Hayes that recombination in *Escherichia coli* involves two mating types, F^+ and F^-, the latter being characterized by inability to mate with other F^- strains. It was believed that recombination involved pairing between an F^+ and an F^- organism followed by the transfer, by an unknown mechanism, of genetic material from the F^+ donor to the F^- recipient. The transfer was followed by crossing over and incorporation of a portion of the donor's genes.

A variant of F^+ called HFr (high frequency) is characterized by a 1000-fold increase in the frequency of recombination of certain linked genes, thus making quantitative studies much simpler. In the Hayes strain the HFr character affects the recombination rate of the linked genes $TLAzV_1LacGal$ (Threonine and Leucine requirements, Azide sensitivity, Virus T1 sensitivity, Lactose and Galactose fermentations), giving recombination frequencies of the order of 1 to 10 percent of the initial number of the HFr parent, but it does not affect the unlinked character S^s (Streptomycin sensitive).

The experiment involved crossing $HFrT^+L^+Az^sV_1{}^sLac^+Gal^+S^s$ with $F^-T^-L^-Az^rV_1{}^rLac^-Gal^-S^r$ and selecting recombinants with the characteristics $T^+L^+S^r$ by plating on a medium that lacked threonine and leucine and contained streptomycin. These recombinants were then tested for the presence of other markers from the HFr parent, with the result that, of the $T^+L^+S^r$ recombinants, 90 percent were Az^s, 75 percent were $V_1{}^s$, 40 percent were Lac^+, and 25 percent were Gal^+.

The kinetics of recombination were then studied by removing samples of the mating bacteria at various times after mixing the two bacterial populations and interrupting the mating process by violent agitation in a homogenizer to separate the mating pairs. The population was then assayed for recombinants. It was found that there was a lag period of about 10 min before the first $T^+L^+S^r$ recombinants were formed, after which the number of such recombinants increased rapidly, reaching a maximum by 50 min. Disturbance of the mating pairs during the first 10-min period prevented introduction of these HFr linked gene loci. The azide locus was introduced simultaneously with the T^+L^+ loci, as was expected from the close linkage noted in the preceding paragraph. The V_1 locus arrived about 11 min, the Lac locus about 18 min and the Gal locus about 29 min after the start of mating.

These experiments suggest that the HFr segment of the bacterial chromosome is an organized structure containing a linear array of gene loci, and that these loci penetrate into the bacterial cell in a predetermined order at a slow enough rate so that the procedure can be interrupted by mechanical treatment at various times. The interruption of the mating process does not prevent the genetic fragment that has already entered the recipient cell from being incorporated in the recipient's nucleus. This mechanical separation of mating pairs has an end-result similar to that observed in the phenomenon of transduction in which a bacterial virus serves as a vector for the transmission of fragments of genetic material from a donor bacterium to a recipient bacterium.—M.H.A.

AEC Technical Libraries

The Atomic Energy Commission has announced that technical libraries of nonclassified data on nuclear energy and its applications have been shipped to 23 nations. These comprehensive collections, each containing the equivalent of documents that would fill 250 ft of library shelving, were developed by the AEC Technical Information Service as one of the several commission projects supporting the President's Atoms-for-Peace program. Fifteen of the libraries were shipped from the document distribution center at the AEC's Oak Ridge Operations Office on 11 July; eight libraries had been sent earlier.

Each gift library, weighing approximately 1000 lb, consists of approximately 6500 AEC research and development reports, 5000 of which are on microcards; 22 miscellaneous books; 34 bound volumes of scientific and technical texts on nuclear theory; and 11 bound volumes of abstracts of some 50,000 reports and articles published in this country and abroad. Each collection also will include approximately 55,000 index cards, which will be shipped later.

The individual collections duplicate material now available in 42 repository libraries in the United States, three in the United Kingdom, and one each in Belgium and Canada. The 23 countries to which the libraries have been shipped are Italy, Spain, Australia, Sweden, Greece, Egypt, Burma, Denmark, Austria, Philippines, Finland, Turkey, Netherlands, New Zealand, Portugal, Peru, South Africa, Israel, Norway, India, Argentina, France, and Japan.

Itching, a Primary Sensation

The sensation of itching (pruritis) has long been a physiological puzzle. In contrast to the sensations of pain, touch, heat, and cold, itching has consistently demonstrated an indifferent response to physical stimuli. It now appears, from experiments reported by R. P. Arthur and W. B. Shelley [*Nature* **175**, 901 (1955)], that itching is a primary sensation, distinct from pain; in contrast to the other primary sensations, it is not engendered by physical modalities but by chemical stimuli. In the work reported, the proteolytic enzymes were found to be implicated as the true stimulus for itching. The most active enzymes (mucunain, papain, chymotrypsin) produced itching with the shortest latent period and the longest duration. Increasing their concentration in solutions decreased the latent period and increased the duration and intensity of action. Pain was never observed. The mechanism of the pruritogenic action is unknown; but a synthesis or release of an active compound from epidermal cells, perhaps intracellular proteinases (cathepsins), is suggested. Experiments indicate that histamine is not implicated. —W.L.S., JR.

News Briefs

■ The idea of a control over the weather through artificial "seeding" of clouds is scheduled for a new series of tests. In the past, the Office of Naval Research has carried out a varied program to arrive at some conclusions about controlling weather through seeding with dry ice particles from aircraft and with silver iodide crystals from ground generators. An interested party to the series of experiments and tests was the Weather Evaluation Board appointed by President Eisenhower.

In April some results were announced

on a series of tests carried out by Operation SCUD sponsored by the Office of Naval Research and conducted by a group of specialists at New York University [*Science* **121**, 629 (29 Apr. 1955)]. These tests were conducted along the East Coast and extended from operational areas as far north as Massachusetts to others as far south as Florida. The evaluation of the results from Operation SCUD was by an outside group headed by John Tukey at the Forrestal Research Center, Princeton, N.J. On the basis of this evaluation, a statement was released which said, "No evidence of any large-scale meteorological effects due to seeding."

The feeling developed within the President's Advisory Committee on Weather Control that while wide-area control was not effective, there might be possibilities of success in an operation of somewhat limited scope. Thus plans have been laid for Operation OVERSEED, which will test cloud-seeding methods from the foot of Mount Washington, highest of the White Mountains in New Hampshire. The project will begin in the fall. Silver iodide crystals will be dispersed by 10 generators used in Operation SCUD and by other types favored by commercial operators.

■ Scientists assigned to the Air Research and Development Command from the Geophysics Research Directorate of the Air Force Cambridge Research Center began balloon launchings on 5 July at Orlando Air Force Base in Florida to study the electric charges set up by thunderstorms. Information was telemetered to ground-based receivers and collected for future studies of basic facts concerning the tremendously powerful electric impulses that are generated.

Two other Air Force bases aided in the project. Radar stations at Patrick Air Force Base, Cocoa, Fla., and at Pinecastle Air Force Base, Orlando, checked the height and position of the thunderclouds and tracked the balloons in flight.

The effect of lightning discharge on the normal earth's electric field was studied simultaneously with the balloon investigations. Instruments mounted on mobile trucks were used in the lightning discharge tests.

■ Chemists at New York University have synthesized chaulmoogric acid, until recently the drug most commonly used for the treatment of leprosy. Their findings are reported in the 20 July issue of the *Journal of the American Chemical Society*. Because chaulmoogric acid has been largely replaced in leprosy treatment in the last 5 years by synthetics, any therapeutic benefits of the work are secondary, according to Kurt Mislow, assistant professor of chemistry in the University College of Arts and Science. He and I. V. Steinberg, former N.Y.U. research fellow, published the report.

Of chief importance is the insight the synthesis gives into the molecular structure of certain fats. Of all the seed-fat acids, chaulmoogric is unique in being a cyclic, unsymmetrical structure. Its two stereoisomers are the same when they are represented in a projection formula but are different, structurally, in space. One form is the mirror image of the other, but the two are different when they are viewed in three dimensions, and only one of the forms, the dextrorotatory one, occurs in nature. Besides synthesizing the natural form, Mislow and his colleague determined its spatial arrangement and thus, automatically, that of the unnatural or levorotatory form.

Scientists in the News

THOMAS M. RIVERS, vice president and director of the Rockefeller Institute and director of the institute's hospital, will retire in October after 33 years of service. However, he will continue his association with the institute on an emeritus basis. Rivers graduated from the Johns Hopkins Medical School in 1915.

After serving as resident in pediatrics and instructor in bacteriology at Johns Hopkins, he joined the Rockefeller Institute in 1922. He became a member of the institute in 1927, director of the hospital in 1937, and has been vice president and director since 1953.

Rivers is an authority on virus diseases and a leader in medical research in this country. He is a member of the National Academy of Sciences, the Board of Health of the City of New York, the Public Health Research Institute of New York, and the Advisory Committee of the National Foundation for Infantile Paralysis. During World War II he held the rank of commodore in the U.S. Naval Reserve and was in charge of the Naval Research Unit at Guam.

With the announcement of Rivers' retirement, Detlev Bronk, president of the institute, also announced two new appointments: FRANK L. HORSFALL, JR., a member of the institute, has been named vice president for clinical studies and physician-in-chief, and DOUGLAS WHITAKER, now provost and professor of biology at Stanford University, has been appointed vice president for administration.

Simultaneously, Bronk announced the merging of the institute's department of the laboratories and department of the hospital. The former positions of director of the institute and director of the hospital will not be filled because of this reorganization. This fall the institute plans to add an academic program to its long-established work in medical research. The first class, which will be made up of graduate students on fellowships from the institute, will enroll in September.

On the occasion of his 70th birthday, ALFRED KÜHN, director of the Max-Planck-Institute for Biology in Tübingen, was awarded an honorary doctor of medicine degree by the University of Göttingen, and was also presented with the Gauss-Weber medal.

RALPH F. FUCHS, professor of law at Indiana University, will become general secretary of the American Association of University Professors on 1 Sept. He succeeds Ralph E. Himstead, who died on 9 June.

The association has a membership of more than 43,000 teachers in 968 colleges and universities. The general secretary is the chief permanent officer of the association, and is in charge of its central office, which is in the American Council on Education Building, 1785 Massachusetts Ave. NW, Washington 6, D.C.

J. A. STRATTON, provost of Massachusetts Institute of Technology, and MERVIN J. KELLY, president of Bell Telephone Laboratories, have been elected chairman and vice chairman, respectively, of the Naval Research Advisory Committee of the Office of Naval Research. Stratton succeeds JOHN A. HUTCHESON, vice president and director of the Westinghouse Electric Corp., and Kelly assumes the vice chairmanship previously held by Stratton.

A. B. KINZEL, vice president of research for the Union Carbide and Carbon Corp., whose tenure with the committee recently expired, has accepted appointment for an additional 3 years. FREDERICK SEITZ, director of physics, physics department, University of Illinois, was also recently appointed a member of the committee.

Other members of the Naval Research Advisory Committee are A. V. ASTIN, director, National Bureau of Standards; R. E. DYER, director of research, Emory University Hospital; J. C. HUNSAKER, head of the department of aeronautical engineering, Massachusetts Institute of Technology, and chairman of the National Advisory Committee for Aeronautics; I. R. RABI, department of physics, Columbia University; WILLIAM R. SEARS, dean of the Graduate School of Aeronautical Engineering, Cornell University; E. H. SMITH, director, Woods Hole Oceanographic Institution; E. N. STEPHENS, vice president, central research department, Minnesota Mining and Manufacturing Co.; J. E. W. STERLING, president, Stanford University; and GEORGE D. STODDARD, former president of the University of Illinois.

The German Chemical Society, meeting in Frankfurt a. M., recently awarded the Liebig memorial medal to FEDOR LYNEN, professor ordinarius of biochemistry at the University of Munich, in recognition of his fundamental researches on the biological synthesis and degradation of the fatty acids and the role of coenzyme A in their activation.

On 27 July, ALLAN HANCOCK received a volume entitled *Essays in Natural Science in Honor of Captain Allan Hancock* from the staff of the Allan Hancock Foundation of the University of Southern California. Hancock was director of the foundation from 1940 to 1954. Commemorating his 80th birthday, the 350-page *Festschrift* contains 24 articles on varied subjects by scientists from this country and abroad who have participated during the last 25 years in the expeditions of the *Velero III* and *Velero IV*, or in related endeavors in marine biology and oceanography.

Henceforth the foundation will function under the direction of A. S. RAUBENHEIMER, educational vice president. The operation of the *Velero IV* for the coming year has been assured by Hancock. The foundation's collections will continue to be available to specialists for study, and ways are being sought to continue the extensive series of publications on expedition results.

WILLIAM M. SILLIPHANT, deputy director of the Armed Forces Institute of Pathology since 1952, has been appointed director. He succeeds ELBERT DECOURSEY, whose tour of duty ended on 1 Aug. DeCoursey will become commandant of the Medical Field Service School at Brooke Army Medical Center, San Antonio, Tex.

SIDNEY W. NELSON, assistant professor of radiology at the University of Chicago, has been appointed professor and chairman of Ohio State University's department of radiology. The acting chairman for the past year has been JACK WIDRICH, who has joined the staff of the University of Miami.

ROBERT L. VOUGHT, former associate professor of epidemiology, Columbia University, has joined Bristol Laboratories, Inc., Syracuse, N.Y., as associate medical director. He will make his headquarters in Bristol's New York office.

GEORGE B. CRESSEY, Maxwell professor of geography at Syracuse University, left on 5 Aug. for a year of research on water problems in Southwest Asia. His headquarters will be in Baghdad, Iraq, and he plans to travel widely.

The Syracuse department of geography has a rotating scheme whereby at least one member of the staff is always on leave for fieldwork. During the past year, JOHN THOMPSON has been in Japan, and HIBBERD KLINE has worked in Africa.

M. O. WILSON will retire on 1 Sept. as chairman of the department of psychology at the University of Oklahoma but will continue as professor. CARL R. OLDROYD succeeds him as chairman. Another member of the department, MUZAFER SHERIF has been named director of the newly established Institute of Group Relations.

The following appointments to assistant professor have been announced. Dickinson College: WILLIAM H. BENSON, mathematics. Harvard School of Public Health: THEODORE B. VAN ITALLIE, clinical nutrition; FRANKLIN A. NEVA, tropical public health. West Virginia University: MASON E. HALE, JR., biology. Union College: THOMAS L. FINCH, physics. Pennsylvania State University: THOMAS SMYTH, JR., entomology.

Necrology

RAYMOND C. ARCHIBALD, Providence, R.I., 79, professor emeritus of mathematics at Brown University, author, editor, past president of the Mathematical Association of America, twice a vice president of AAAS, 26 July.

CHARLES T. BRUES, Cambridge, Mass., 76, professor emeritus of entomology at Harvard University, 22 July.

WELDON S. CALDBECK, Hillside, N.J., 42, chemical engineer, 23 July.

FRANK W. CARPENTER, Santa Barbara, Calif., 74, former head of the research department of General Mills Corp. in St. Paul, Minn., 24 July.

JOHN W. E. GLATTFELD, Chicago, 72, associate professor emeritus of chemistry at the University of Chicago, research consultant at the Argonne National Laboratory, 26 June.

MARTIN L. KATZENSTEIN, New York, 75, marine engineer, 21 July.

GEORGE C. KEEFE, West Hartford, Conn., 50, chief of the department of medicine at St. Francis' Hospital, 21 July.

CHARLES F. W. MCCLURE, Princeton, N.J., 90, professor emeritus of zoology at Princeton University, 23 July.

JACOB J. MENDELSOHN, Chicago, 64, professor of medicine at Stritch College of Medicine of Loyola University, director of Fox River Sanatarium, Batavia, Ill., 26 July.

GLADYS A. REICHARD, New York, 62, professor of anthropology at Barnard College, secretary of AAAS Section H in 1945, 25 July.

HOWARD C. SHAUB, Washington, Pa., 63, head of the mathematics department of Washington and Jefferson College, 20 July.

WILLIAM H. SCHULTZ, New York, 83, retired pharmacologist and medical scientist, 24 July.

WILLIAM SEIFRIZ, Philadelphia, 66, professor of botany at the University of Pennsylvania, 13 July.

GEORGE F. SIMMONS, Glen Ellyn, Ill., 60, former president of Montana State University at Missoula, member of the School of Medicine staff of Loyola University, 19 July.

WILLIAM H. WARN, Little Silver, N.J., 69, retired mining engineer, 25 July.

Education

■ The Alfred P. Sloan Foundation has announced a grant of $750,000 to Cornell University for the establishment of the Sloan Institute of Hospital Administration. A principal aim of the new unit will be to train a select group of students for careers in hospital administration.

The program of study, which will lead to the degree of master of public administration in hospital management, or, with slightly different emphasis, to the degree of master of business administration in hospital management, will require 2 years of intensive work in Ithaca and a year of residency in an appropriate hospital. The number annually accepted for the training will be limited to about a dozen highly qualified applicants. To insure that only the best qualified will be admitted to the course, the foundation's grant for the new institute has included a generous provision for fellowships.

■ The *Engineering and Scientific Manpower Newsletter* (5 July 1955) published by the Engineering Manpower Commission and the Scientific Manpower Commission, carries a list of suggestions for steps that can be taken by industry and professional society local sections to help resolve the science-teacher problem. Since the suggestions are very pertinent to the AAAS Science Teaching Improvement Program, we reprint them here.

Under the title, "Brass tacks and science teachers," the commissions state that this list was prepared in response to numerous requests for information about specific ways by which the local groups could tackle the problem. The Newsletter points out that although the problem "can be described nationally it can be attacked only locally." The list includes the following questions and suggestions addressed to local groups.

1) *What can you do to improve the quality of science teaching in your community?* (i) Is the most efficient use being made of the present science teachers in your community? Work through

your school administrators here. Do the teachers teach science subjects only? What extra curricular work of a non-science nature are they required to do? Are they given time to make adequate preparation for demonstration and student laboratory work? Are visual aids and trips to museums and industrial neighbors made available to science classes? Is transportation an obstacle to the afore-mentioned trips? (ii) Make available to science teachers such aids as motion pictures, charts, pamphlets, and brochures that specifically relate your field of work to the teaching of science. (iii) Furnish speakers to schools or science classes to stimulate the work of the students. (iv) Provide summer work for science teachers to aid them financially and to give them on-the-job experiences. (v) Encourage your science teachers to take advantage of such summer programs as those offered by General Electric and Westinghouse. (vi) Arrange for industry-sponsored inservice programs, such as the one being conducted at the Niagara Frontier. (vii) If programs such as those mentioned in (v) are not available to teachers in your area, why not start one? (viii) Encourage your science teachers to visit local industries and to become familiar with their problems. (ix) Never criticize the teachers within the hearing of your children. Many criticisms have their bases in misunderstandings that school officials can usually clarify. (x) When new schools are being built in your community, be sure that adequate facilities for science are included. This includes enough space for individual laboratory work by all students. (xi) Offer your services as a judge, or to work on a committee, for your local Science Fair or Science Congress. If one does not exist in your area, help start one. (xii) Offer your services as a consultant to your local science teachers' association. (xiii) See that up-to-date textbooks are made available in all science classes in your local schools. (xiv) Remember that mathematics and science are inseparable. Work with your school administrator for a good mathematics program also. (xv) Urge administrators to use no nonscience-trained teachers to teach science, especially in the very critical junior-high-school classes.

2) *How can you help to attract well-qualified young people into a science-training career?* (i) Talk up the importance of science teaching in our secondary schools. Young people want to feel the importance of what they are doing. (ii) Compare your local teachers' salary scale with that paid by industry. You may find a reasonable comparison at the beginning, but will an ambitious young person find the same opportunities for rapid advancement that he can expect in industry? (iii) Urge better counseling in teachers' colleges and other teacher-training schools toward science teaching as a career. (iv) Furnish speakers to these schools and to high-school assemblies, dramatizing the role of science teachers in our economy and defense. (v) Sponsor radio and TV programs to this same end. (vi) Award scholarships specifically aimed at preparing science teachers, with some insurance that the recipient will teach science. (vii) Offer summer work opportunities to young people who are training to be science teachers, to help them financially and to give them industrial experiences, but with the specific understanding that their preparation for science teaching is the all-important reason for the employment.

■ As a result of action taken by the American Council on Pharmaceutical Education at a meeting held in Chicago in June, the council's List of Accredited Colleges of Pharmacy, dated 1 July 1954, was revised, and the printing and distribution of a new list, dated 1 July 1955, was ordered. Of the 74 accredited colleges of pharmacy that comprise the list, 69 are now designated as class A, 2 as class B, and 3 as class C colleges.

■ The department of chemistry of the Polytechnic Institute of Brooklyn announces that during the fall semester it will offer a weekly series of 2-hr lectures on group theory and its application to various problems of interest in chemistry and physics. The course will be designed to familiarize graduate students and research workers in various branches of physical chemistry and chemical physics with the principles and techniques of group theory and its use as a research tool. The success of group theory in treating symmetry relationships and their connection with physical properties will be illustrated by examples chosen from diverse fields of science. Further information may be obtained by writing to Prof. E. M. Loebl, Polytechnic Institute of Brooklyn, 99 Livingston St., Brooklyn 1, N.Y.

■ The Minneapolis-Honeywell Regulator Co. recently announced plans for the establishment in Perivale, England, of a technical training school to groom engineers and other technical personnel in the use of automatic control equipment used widely in the United States. Classes for the first year will comprise M-H personnel from Great Britain, Holland, Switzerland, Sweden, Belgium, and Germany. Later plans call for attendance by customer students from British and western European industrial firms. The industrial control devices to be studied at the school include a variety of automatic recording, measuring, and controlling instruments that are typical of the automation pattern that is growing rapidly in this country. European industries are increasing the use of these instruments primarily because they introduce higher production per unit of labor and better quality control, thus lowering costs.

■ A teaching professorship in chemical engineering will be established at Cornell University's School of Chemical and Metallurgical Engineering with funds given by Socony Mobil Oil Co. A nationally recognized chemical engineer, between the ages of 35 and 45 and with strong industrial experience, will be sought to fill the chair. In an effort to help keep his teaching closely related to industrial problems and trends, the professor will be encouraged to consult with industries served by chemical engineers.

■ A graduate study program in physiological chemistry for the master's and doctor's degrees has been established at the University of California, Berkeley and San Francisco. This program emphasizes training and research on the chemistry and metabolism of the vertebrates. Information may be obtained from Prof. David M. Greenberg, Department of Physiological Chemistry, Berkeley 4, Calif.

■ The University of Virginia will offer a new degree of doctor of science in engineering-physics to students who combine work in the School of Engineering and the department of physics.

Grants, Fellowships, and Awards

■ The president of the AAAS, George W. Beadle, with the unanimous approval of the board of directors, has appointed the following judges for this year's Theobald Smith award: Rene J. Dubos, member, Rockefeller Institute for Medical Research; Severo Ochoa, professor of biochemistry, New York University College of Medicine; Chester S. Keefer, director, Robert Dawson Evans Memorial Hospital, Boston, Mass.; and Karl Mason, professor of anatomy, University of Rochester School of Medicine and Dentistry.

S. E. Luria, professor of bacteriology at the University of Illinois and vice president of AAAS Section N, Medical Sciences, serves *ex officio* as chairman of this committee; and Allan D. Bass, professor of pharmacology at Vanderbilt University School of Medicine, as secretary of Section N, will serve as secretary.

■ Award of 64 unclassified life-science research contracts in biology, medicine, and biophysics has been announced by

the U.S. Atomic Energy Commission. Twenty-one of the awards, each of which is for 1 year, are new projects; 12 are in biology; 8 are in the medical sciences; and 1 is in biophysics. There were 43 1-year contract renewals: 21 in biology; 21 in medical sciences; and 1 in biophysics.

■ A gift of $500,000 has been made by the H. J. Heinz Co. Foundation, the Howard Heinz Endowment, and H. J. Heinz, II, to Children's Hospital, Pittsburgh, Pa., for the establishment of research chemical laboratories that are to be known as the Heinz Laboratory of Children's Hospital. The laboratory will be part of a new building now being planned.

■ Applications for awards available 1 July 1956 will be received by the Life Insurance Medical Research Fund as follows:

Postdoctoral research fellowships. Deadline, 15 Oct. Preference is given to those who wish to work on cardiovascular function and disease or related fundamental problems. Minimum stipend, $3600, with allowances for dependents and necessary travel.

Research grants to institutions. Deadline, 1 Nov. Support is available for physiological, biochemical, and other basic work broadly related to cardiovascular problems as well as for clinical research in this field.

Predoctoral fellowships will not be offered by the fund this year. Further information and application forms may be obtained from the Scientific Director, Life Insurance Medical Research Fund, 345 E. 46 St., New York 17.

■ The 6-month-old Fund for Peaceful Atomic Development, Detroit, Mich., has recently received two grants: the first, of $50,000, was a gift of the Rockefeller Brothers Fund; and the second, for $5000, was provided by the Johnson Foundation, a foundation established by the owners of the Johnson Wax Co. The grants were announced by Walker L. Cisler, president, and Joseph M. Dodge, treasurer of the fund. Cisler is the president of the Detroit Edison Co., and Dodge is chairman of the Detroit Bank and special assistant to the President on the Council of Foreign Economic Policy.

The money will be used by the fund to support the objectives of the President's Atoms-for-Peace program. By private channels the fund is helping to bring about world-wide cooperation in atomic energy matters through a program to provide maximum interchange of information.

Active contacts have been made or projects have been undertaken in a substantial number of countries, including India, Pakistan, Turkey, Egypt, Japan, Mexico, Canada, Belgium, France, Italy, Switzerland, Denmark, and Germany.

Several projects have been undertaken to send Americans well-known in the atomic field to other countries to aid in atomic energy programs. Lawrence R. Hafstad, director of the atomic energy division of the Chase Manhattan Bank, visited India, Pakistan, Turkey, and several other countries for the fund early this spring.

One of the recent activities of the 6-month-old organization was to arrange a trip to Mexico for E. Blythe Stason, dean of the University of Michigan Law School and managing director of the fund, and Henry Gomberg, professor of engineering and assistant director of the Michigan Memorial Phoenix Project in atomic energy. These men are concerned with the legal and engineering aspects of atomic energy. Their visit was made at the invitation of the National University of Mexico and the Mexican Light and Power Co. As a result, half a dozen students will return to this country to learn more about nuclear matters. A close relationship is being built between the University of Michigan and the National University of Mexico and other institutions in that country.

The fund has also undertaken to send an American adviser to Egypt to spend a year helping in the formation of a radioisotope center in the Egyptian National Research Council. Establishment of the fund has stimulated the formation of parallel organizations in other countries. Early in June the Association Belge pour le Développement Pacifique de l'Energie Atomique was founded in Belgium. Interest has also been evident in Canada, Mexico, India, Germany, Switzerland, and Denmark in forming similar privately sponsored organizations for national and international programs.

■ A $100,000 trust fund for cancer research at the Medical Center of the University of California, Los Angeles, has been established by James and Lorena Greims of Encino, Calif. The fund will be used for the study of certain surgical problems associated with cancer. This research will be under the direction of G. A. Stevens, clinical professor of surgery. He will be assisted by David B. Shelton.

■ An appropriation for postgraduate study in medical schools has been announced by Stacey's, medical book distributors, of San Francisco, as a memorial to its founder, John W. Stacey. To each of the medical schools in the 11 western states will be allocated $500 in cash, plus a sum of $100 for the purchase of medical books. The dean of each medical school will set the criteria and formula for the awarding of the appropriation, which is intended to aid outstanding graduate students who have impressive scholarship records but who have exhausted their financial resources.

Miscellaneous

■ "Insects and Diseases of Vegetables in the Home Garden," a new publication, has been issued by the U.S. Dept. of Agriculture. Its four-color plates, 45 drawings of insects, and text describing more than 100 insects and diseases that attack vegetables, are expected to help home gardeners recognize the more common pests. The bulletin recommends insecticides and fungicides that recent research has found most effective, safe, and economical for pest control. Single copies are available from the Office of Information, U.S. Dept. of Agriculture, Washington 25, D.C.; ask for Home and Garden Bulletin No. 46.

■ *Signs of the Health Times,* a 64-page report of the 1955 National Health Forum on "Forecasting America's health," 22–24 Mar., is now available at $1 a copy from the National Health Council, 1790 Broadway, New York 19. Members of the council, 50 national organizations interested in health betterment, conduct the forum each spring to consider health questions of broad reach.

The report offers summaries of the present, and expectations for the future, in many areas of information, including: economic trends and their probable effects on health efforts; what atomic developments mean healthwise; new miracles to expect from medical science, and how social science can help us benefit from them; the health manpower situation and NHC's Health Careers program; the role of mass communications media in health betterment; fluoridation as a unique public health case-history-in-the-making and as an opportunity to study the interaction of community health forces; what communities can do about chronic illness; probable impact of the Hoover Commission's health recommendations.

■ *The American Heart Association Serves the Physician,* a booklet listing and describing the professional services of the association, is now available. The publication summarizes the research support program of the AHA. It gives information on the availability of professional education aids prepared by the association, including films, audio-visual presentations, medical literature, heart models, and charts. It also describes the periodicals published by and for the association. Copies may be obtained from AHA, 44 E. 23 St., New York 10.

Reports and Letters

Critical Experiment in Electrocardiography

A critical experiment (*1*) designed to determine applicability of the fixed-location dipole representation of normal ventricular depolarization and influence of human body inhomogeneities on body surface potentials produced by electrical activation of heart muscle has been carried out on an intact normal male subject. The over-all experiment was indirect; QRS complexes at points distributed over the entire human torso were compared in exacting quantitative detail with potentials produced at corresponding points on the surface of an accurate, life-size, homogeneous torso model of the same subject by an internal fixed-location dipole whose moment and orientation were variable.

Equivalent dipole representation. If ventricular depolarization is exactly representable by a fixed-location equivalent dipole insofar as body surface potentials are concerned, theory dictates (*2*) that innumerable unique pairs of body surface points must be found at which QRS complexes (measured with respect to any arbitrary junction of resistors connected to two or more body surface points) possess exactly the same shape, opposite polarity, and usually different amplitude. In short, exact mirror patterns must exist (*3*). Therefore, the degree to which two QRS waveforms lack this exact mirror property (assuming the closest match has been found experimentally) is a measure of the inapplicability of the fixed-location dipole concept. Direct experimental measurements, using a precision four-electrode cancellation technique (*2*), of instantaneous differences between pairs of complexes were conducted with painstaking search for exact mirror patterns at points widely dispersed over the entire body surface of the subject. Thirty-eight successful cancellations on the same subject were obtained. These results, which include many cases in which one and two precordial electrodes were employed, signified that approximately 95 percent of the QRS complex at any body surface point on this subject could be attributed to a fixed-location equivalent dipole.

Equivalent dipole location. Theoretical analyses of idealized models (*4*) and experimental measurements on torso models (*5*) reveal that boundary potentials are extremely sensitive to location of the immersed dipole that produces them. Consequently, a meaningful comparison between model and human for the purpose of investigating inhomogeneity influence must first provide for establishing the fixed location of the dipole in a precise manner. A novel method (*6*) was devised to establish the anatomic location of the equivalent dipole to within $\pm\frac{1}{2}$ cm by a very sensitive technique. A by-product of this determination also permitted construction of a two-resistor terminal tailored to the individual subject that was within ± 0.2 mv of the dipole midpotential (*6*). This terminal is more accurate than the Wilson central terminal, which had a peak-to-peak amplitude of 0.8 mv with respect to the two-resistor junction for this subject.

Although inhomogeneity influence was revealed at this stage by quantitative comparison of all human cancellation data with predictions from the homogeneous model of known dipole location, results were in rather abstract form. Therefore, additional measurements were performed to illustrate in more tangible terms the composite effects of both inhomogeneity and dipole discrepancies between human and model. A two-channel electrocardiograph with uniform amplitude response up to 300 cy/sec was used to obtain precise, high-gain synchronous records at paper speeds of about 400 mm/sec (*7*).

Determination of dipole components. Knowledge of the equivalent dipole anatomic location enabled selection of innumerable bipolar leads on the torso model that bore known proportionality to any one of the model dipole components (*8*). Potential differences on the subject at points based on model prescriptions conformed closely in shape and amplitude to model predictions. For each dipole component, six independent potential differences were measured on the subject at widely scattered anatomic points dictated from the model, and an instantaneous average of these determinations was taken as the best estimate for each component. Results (*7*) differed markedly in shape, amplitude, and relative timing from deductions made from all systems of spatial vectorcardiography presently in use.

QRS complex records. One hundred and ninety different records of the QRS complex were made on the same subject for a wide variety of bipolar and unipolar leads. These records were compared analytically in both amplitude and shape with potential differences produced on the homogeneous torso model at corresponding points by a dipole (fixed in the previously determined location) whose moment varied in time in accordance with the three established components. Peak-to-peak amplitudes calculated from the torso model agreed within ± 10 percent with those measured on the human subject for half of the 190 cases; three-fourths of the cases agreed within ± 20 percent. The amplitude correlation coefficient, $r = 0.94$, was calculated for all 190 cases. In two-thirds of the cases the maximum instantaneous difference between recorded and calculated waveshape, with calculated waveshape normalized to the peak-to-peak value in the record, was less than 15 percent of the peak-to-peak amplitude.

Absolute instantaneous equipotentials were also calculated from these data for several instants during the QRS complex for pictorial representation of results. A typical example is shown in Fig. 1. The zero equipotential equals the dipole midpotential in the case of the torso model, and it equals the potential of the two-resistor junction, mentioned previously, in the case of the human subject.

Numerous sources of error, which are responsible for a substantial portion of the differences between human and

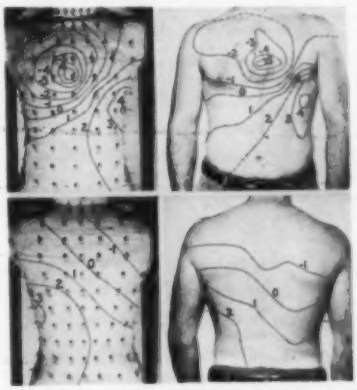

Fig. 1. Absolute quantitative comparison of instantaneous equipotentials, superimposed on front and rear photographs of subject and his torso model, for normal QRS complex and dipole in homogeneous model. Spacing between adjacent equipotentials is 0.25 mv. Dipole moment at this instant, 10 msec prior to the R-wave peak in lead II, is 0.37 ma cm [assuming an average human body resistivity of 1000 ohm cm (*10*)] and is directed backward, downward, and to the subject's left. Reorientation of the model dipole so that it is directed slightly more forward (within limits of experimental error) would reduce the small systematic errors.

model results, have been carefully estimated to contribute uncertainties of ± 15 percent. Approximately two-thirds of all results fell within this range of experimental error.

Results of this critical experiment indicate that a quantitative theory accurate to approximately ± 15 percent for body surface potentials produced by normal ventricular depolarization may be based on the assumptions of a fixed-location equivalent dipole and a homogeneous, linear, resistive conducting medium. Torso shape and, more important, dipole location are critical factors that cannot be ignored. Although the results pertain to only a single subject, they are nevertheless suggestive that three-dimensional homogeneous torso models may be surprisingly pertinent for the establishment of an accurate, quantitative basis for human electrocardiography.

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8 April 1955

Compositional Lineation and Its Relation to Complex Folding

A three-dimensional study has been made of the form and relationships of compositional lineation in gneisses of several types.

Most of the linear units are composed of several or more grains of a mineral or minerals that form miniature chemical concentrations. As these mineral masses increase or decrease in number and size, the composition of the rock changes. They are approximately parallel to the plane of foliation or mineral layering.

Quartz, the latest mineral in the gneisses, forms linear masses in the plane of foliation that appear to be separate and scattered. Study in three dimensions, however, shows that these linear masses form a connected network of curving veins along small folds and also along curved fractures.

It is believed that the linear units were formed by metasomatism, with little or no change in volume along deviations of planar features undergoing movement of one wall or surface in relation to an opposite wall or surface (*1*). The thickest parts of the quartz veins are believed to have formed in the deviations nearest the tensional direction of the shear fracture, and the thinnest parts are believed to have formed in the deviations farther from the tensional direction. Such a vein may continue into parts of the planar feature that contain little or no quartz. The end of the vein is probably nearest to the theoretical position of the shear plane. The introduction and removal of minerals is believed to be synchronous with folding.

Oriented specimens of gneiss were mounted in brass cylinders, and photographic enlargements were made of many surfaces cut 1 mm apart. Tracings of the quartz veins or masses were made on transparent film. The resulting maps of these levels give information that is used to determine the relative direction of motion of the layers in the rock during its folding. Such determinations agree with results obtained by three other new methods that I have devised.

Synchronous folding of layered rocks along axial directions at large angles to one another appears to be common. Generally the folding on one axial direction has a relatively small radius of curvature around a large element of arc, whereas the folding on the other axial direction has a relatively large radius of curvature around a small element of arc (arcuate fold). Since folds are rarely analyzed and discussed in three dimensions, the folding that is related to the axis of relatively large radius of curvature around a small element of arc is usually neglected. Plane sections that are made to display the folding in an area are generally made transverse to the principal axis.

Compositional lineation and the axes of small drag folds appear to be perpendicular to the local line of slip. Therefore, these features are "approximately parallel" to the principal axial direction of folding where, as is described in the preceding paragraph, the effect of cross-folding is small.

The compositional lineation and axes of small drag folds are only in a small part approximately parallel to either of the two axes where the synchronous folding is pronounced along two crosswise axial directions. Generally these linear elements are markedly nonparallel to either of the axial directions.

The resultants of the vectors of slip have been used on models of cross-folds to analyze such deformation for orientation of compositional lineation and the axes of drag folds. Such diagrammatic models have been constructed for each of the several extreme structures. They can be used to bracket a natural example, after which a model can be made to show the variability of lineation orientation, the position of the main fold axes in relation to the lineation, and the direction of slip on certain parts of the fold.

Vectors have also been used on the planar features in the three-dimensional study of folding. The relative attitude of a planar feature on a fold, such as gneissic layering, as well as the lineation, should be comparable in some significant way with the other planar and linear structures of the same kind. One type of correlation is briefly described here.

The attitude of a planar feature may be described by the horizontal bearing and plunge of the lineation that lies in the plane of layering or foliation and the plunge of a line (slip line) that lies in the same plane and at 90° to the lineation. These two plunge angles are projected onto the horizontal plane as line vectors. The value of their resultant (R), together with the lineation bearing—which also lies in the horizontal plane—permits graphic delineation of relative normal pressures on the planar features and also the position of the axes of cross-folding.

I have devised geometric methods to show whether folding is the usual "competent" type or is the type caused by flowage (*2*). The latter was present in some rocks examined.

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Interaction of Reserpine, Serotonin, and Lysergic Acid Diethylamide in Brain

We have previously demonstrated that reserpine, a tranquilizing agent widely used in the treatment of psychotic states, potentiates the hypnotic effects of hexobarbital and ethanol in mice by a central action (*1*). 5-Hydroxytryptamine (serotonin), a normally occurring substance suspected to be implicated in brain function (*2*), was also observed, in large dosage, to depress mice and to potentiate the action of hexobarbital in these animals (*3*). This potentiating action of serotonin

Table 1. Antagonism of the potentiating action of reserpine by LSD. Adult male mice were given the various drugs intraperitoneally. In the hexobarbital experiments, reserpine (5 mg/kg) and LSD (10 mg/kg) were given 1 hr before hexobarbital. In the ethanol experiments, reserpine (5 mg/kg) was given 1 hr before and LSD (10 mg/kg) was given in two divided doses 1 hr before and simultaneously with ethanol (4 g/kg in 50-percent solution). The duration of hypnosis is defined as the time from the loss to the return of the righting reflex. Values for duration of hypnosis are means ± standard deviation. Figures in parentheses indicate the number of animals in each series.

Hypnotic	Duration of Hypnosis		
	Hypnotic alone	Hypnotic + Reserpine	Hypnotic + Reserpine + LSD
	(*min*)	(*min*)	(*min*)
Hexobarbital (100 mg/kg)	19 ± 6 (12)	68 ± 14 (7)	32 ± 12 (8)
Hexobarbital (150 mg/kg)	63 ± 11 (15)	140 ± 10 (15)	67 ± 14 (15)
Ethanol	40 ± 9 (9)	all > 300 (9)	54 ± 11 (12)

was found to be antagonized by lysergic acid diethylamide (LSD), a compound that produces profound mental disturbances in man (*4*). This paper describes experiments which indicate that LSD also antagonizes the potentiating action of reserpine on hexobarbital and ethanol and that reserpine induces the release of large amounts of serotonin from body depots.

The sleeping times of mice given reserpine and hexobarbital were compared with those of mice given reserpine, hexobarbital, and LSD. Animals given hexobarbital alone served as controls. It was found that reserpine exerted a marked potentiation on the effects of hexobarbital but that LSD antagonized this potentiating action (Table 1). Similar experiments, using ethanol as the hypnotic, again showed that reserpine exhibited a strong potentiating action that was blocked by LSD (Table 1). No effect on the hypnosis produced by hexobarbital or ethanol was observed when LSD was given alone.

The observed similarities of reserpine and serotonin suggested the possibility that some actions of reserpine might be mediated through the release of serotonin normally present in body depots. To test this possibility, reserpine was administered to dogs and the resultant urinary excretion of 5-hydroxyindoleacetic acid (5HIAA), a major metabolite of serotonin (*5*), was measured.

Eleven animals each received, intraperitoneally, 3 mg of reserpine per kilogram of body weight. Urine was collected over a number of 2-hr periods and 5HIAA was determined by the method of Udenfriend *et al.* (*6*). This method involves extraction of the 5HIAA into ether, reextraction of the material into buffer, *p*H 7, and the formation of a colored derivative by reaction with nitrosonaphthol and nitrous acid. In each animal the rate of excretion of 5HIAA-like material markedly increased following the administration of reserpine, remained elevated for 8 hr or more, and gradually dropped to below the normal value (Fig. 1, typical experiment).

The apparent 5HIAA in urine following the reserpine administration was identified by paper chromatography with two solvent systems as described by Udenfriend *et al.* (*6*). Additional evidence for the identity of the material in urine was provided by comparing the absorption spectra of the chromophores resulting from the reaction between the nitrosonaphthol-nitrous acid reagent and the apparent and authentic 5HIAA. These were found to be identical. Finally, the distributions of apparent and authentic 5HIAA between ether and water at various *p*H values were compared according to the procedure of Brodie and Udenfriend (*7*). Both compounds were found to have the same partition ratios.

The excretion of 5HIAA in three of the dogs was determined after a second dose of reserpine was administered the next day (Fig. 1). An increase in 5HIAA excretion did not reoccur. This suggests that the first dose of reserpine had depleted the serotonin depots in the body and that they had not yet been replenished.

Serotonin and reserpine exert a common central potentiating action that is antagonized by LSD. This suggests that certain actions of reserpine may be mediated through the liberation of serotonin. In accord with this hypothesis, there is a marked increase in the urinary excretion of 5-hydroxyindoleacetic acid in dogs following administration of reserpine.

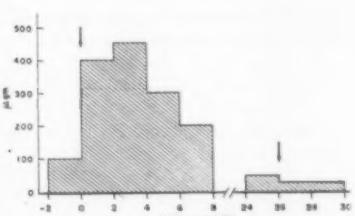

Fig. 1. Effect of reserpine on urinary excretion of 5-hydroxyindoleacetic acid (5HIAA) in the dog. Arrows depict times at which reserpine, 3 mg/kg, was injected intraperitoneally.

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8 April 1955

Osmotic Pressure

In his recent communication J. H. Hildebrand (*1*) has given an interesting account of the role played by osmotic pressure in the theory of solutions. He has omitted, however, to point out the dual nature of the common conception of osmotic pressure; for that reason it is perhaps worth while to expand his explanation with some additional remarks.

Hildebrand uses the term *osmotic pressure* (*1*, p. 117) in the sense of the "... pressure of the solute against a membrane permeable only to the solvent." The pressure of the solute arises from the thermal motions of the solute molecules and, as originally pointed out by van't Hoff, is analogous to the pressure of a gas. In this sense, the osmotic pressure is a measure of the tendency of the solute to expand.

The second picture of osmotic pressure arises from the classical osmotic experiment in which a solution is separated from pure solvent by a semipermeable membrane. From this experiment, the osmotic pressure is defined as the hydrostatic pressure that must be applied to the solution in order to stop the flow of solvent through the membrane. This is the original and, as I shall demonstrate, the exact definition of osmotic pressure.

It has been customary to assume that the pressure of the solute against the membrane is intimately related to the hydrostatic pressure of the classical experiment. In fact, it has often been implied that, in some obscure way, the solute pressure is the cause of osmosis. Haldane (*2*), in 1928, pointed out that it was illogical to assume that the pres-

sure of solute molecules could be responsible for the flow of solvent molecules through a membrane. Nevertheless, this view has persisted and undoubtedly has contributed to the confusion which, according to Hildebrand, still exists. Current ideas on diffusion through membranes (*3, 4*) give a simple and satisfying picture of the classical osmotic experiment; I hope, by a slight expansion of Hildebrand's explanation, to show how the hydrostatic pressure of the osmotic experiment is related to the pressure exerted by the solute molecules.

Osmotic pressure as the hydrostatic pressure required to prevent diffusion of solvent molecules through a membrane. It was suggested some time ago—see, for instance, Glasstone (*5*) or Guggenheim (*6*)—that the selective action of a semipermeable membrane arose from the fact that the membrane was permeable to those molecules that dissolve in it and impermeable to those that do not. This hypothesis assumes that the molecules of the solvent do not diffuse through the membrane as free molecules in pores within the membrane but as molecules attached in some way to the solid. The exact relationship between solvent molecules and the membrane is immaterial for an understanding of osmosis, and it is sufficient to record that the movement of the solvent molecules takes place by some sort of activated diffusion. If this diffusion is through the solid structure of the membrane, the relationship between solvent and membrane can be considered as a solution; if the diffusion is along internal surfaces, then the relationship between solvent and membrane can be considered as an adsorption.

Whether the relationship between solvent molecules and membrane is a solution or an adsorption, it is obvious that at the external surfaces of the membrane the interaction can be most accurately described as an adsorption (*3, 4*); it is the interaction at the surfaces that is important for osmosis. At one surface we have an adsorption of molecules from the solvent and at the other a desorption into the solution. The molecules of the solvent will continue to be adsorbed as long as the activity (or the vapor pressure) of the solvent is greater than that of the adsorbed molecules. Similarly, at the surface in contact with the solution, the molecules will desorb as long as the activity of the adsorbed molecules is greater than that of the solvent molecules in the solution. The transfer of solvent will stop only when the activity of the solvent molecules is the same throughout the whole system. In the typical osmotic experiment the equalization of activities arises through the effect of hydrostatic pressure; the hydrostatic pressure increases until it is just sufficient to raise the activity of the solvent molecules in the solution to that value which they possess in the pure solvent. At that point there is no further transfer of solvent and the system is in osmotic equilibrium.

On the basis of this picture it is easy to obtain an expresison for the osmotic pressure. From thermodynamics,

$$\frac{\partial \log \lambda_1}{\partial P} = \frac{V_1}{RT}, \qquad (1)$$

where λ_1 is the activity of the solvent molecules in the solution, P the hydrostatic pressure and V_1 the partial molar volume of the solvent. By integration we find that the osmotic pressure Π is given by

$$\Pi V_1 = -RT \log \frac{\lambda_1}{\lambda_1^0} = -RT \log \frac{f_1}{f_1^0}, \qquad (2)$$

where λ_1^0 is the activity of pure solvent and f_1 and f_1^0 are the fugacities of solvent molecules in solution and in pure solvent respectively. Equation 2 is the same as Eq. 1 of Hildebrand.

Osmotic pressure as the pressure of solute molecules against a membrane. We see, from the previous discussion, that there is a simple and satisfying explanation for the build-up of pressure in a solution separated from pure solvent by a semipermeable membrane. The problem is to relate this picture to the concept of osmotic pressure advanced by Hildebrand.

Following Hildebrand, we write van't Hoff's law in the form

$$P_2 = c_2 RT, \qquad (3)$$

where we have written P_2 instead of Π so that we may distinguish the solute pressure from the hydrostatic pressure described in the first part of this communication.

Hildebrand has shown how, with the help of Raoult's law, Eq. 3 can be derived from Eq. 2. In order, however, to demonstrate the relationship that exists between the solute pressure P_2 and the osmotic pressure Π we shall use a slightly different approach. By definition (*6*) we know that

$$\mu = RT \log \lambda, \qquad (4)$$

where μ is the chemical potential and λ is the absolute activity. Since

$$\left(\frac{\partial \mu}{\partial p}\right)_T = V, \qquad (5)$$

we have for the pressure P the relationship

$$P = \frac{RT}{V} \log \lambda. \qquad (6)$$

The pressure exerted by the solute molecules in a solution should accordingly be given by the expression

$$P_2 = \frac{RT}{V_2} \log \lambda_2. \qquad (7)$$

Equation 7 is the relationship between the pressure P_2 of the solute and the activity λ_2 of the solute molecules. For comparison with Eq. 2, P_2 must be expressed in terms of the activity of the solvent molecules. To do this it is only necessary to remember that the role played in solutions by the pressure P is analogous to that played by the partial pressure in a mixture of gases. Thus, we have, in an ideal binary solution, the relationship

$$P_1 + P_2 = P^0 = P_1^0 = P_2^0 \qquad (8)$$

where P^0 is the total pressure exerted by all the molecules in the solution and P_1^0 and P_2^0 are the pressures that would be exerted by the pure solvent and pure solute, respectively. We find, accordingly, that

$$P_2 = P_1^0 - P_1. \qquad (9)$$

Since

$$P_1^0 = \frac{RT}{V_1^0} \log \lambda_1^0$$

and

$$P_1 = \frac{RT}{V_1} \log \lambda_1,$$

we can obtain for P_2 the expression

$$P_2 = \frac{RT}{V_1} \log \frac{\lambda_1^0}{\lambda_1} \qquad (10)$$

if we assume that the molar volume of the solvent in the solution is identical with V_1^0, the molar volume of pure solvent. By comparing Eq. 10 with Eq. 2 we see that the pressure P_2 is equal to the osmotic pressure Π.

It is clear from this analysis, however, that P_2 and Π are in fact two separate pressures, and it remains to show how it is that they have the same value. P_2 is the pressure exerted by the solute molecules at the beginning of the osmotic experiment, that is, when the hydrostatic pressure on the solution is atmospheric. At the end of the osmotic experiment, when the hydrostatic pressure is Π, the pressure P of the solute molecules would be increased according to Eq. 1.

From Eq. 9 we see that P_2 is the amount by which the pressure P_1 of the solvent molecules in the solution must be increased in order that it will be equal to the pressure of the molecules in the pure solvent. P_2 is equal to the pressure deficit of the solvent molecules, and since in the osmotic experiment this pressure deficit is eliminated by application of the osmotic pressure Π it becomes obvious why P_2 and Π have the same value. Since they are not the same pressures, however, it is unfortunate that the term osmotic pressure has been indiscriminately applied to both. The pressure P is analogous to the partial pressure of a gas. As pointed out by Hildebrand (*1*, p. 117), in a solution the pressure P ". . . is primarily a consequence of the tendency of two different liquid species, under the

impulse of thermal agitation, to achieve a state of maximum disorder by any available path. . . ." P is, in fact, a measure of the tendency of a component to diffuse (7) and is most aptly described by the term *diffusion pressure*.

One other way of looking at these pressures is enlightening. If, in the preliminary stage of the osmotic experiment, the solvent and the solution were brought into immediate contact by the removal of the semipermeable membrane, then the solute molecules would diffuse into the solvent and the driving force for the diffusion would be the solute pressure P_2. At the same time solvent molecules would diffuse from the solvent to the solution and the force driving this diffusion would be the diffusion pressure deficit of the solvent molecules in the solution, which, as has been demonstrated in the previous paragraphs, is also equal to P_2. With the membrane in place, however, the diffusion of solute molecules is prevented by the resistance of the membrane, and the diffusion of solvent molecules through the membrane takes place by the mechanism outlined in this paper, namely, adsorption at one surface, diffusion through the membrane and desorption at the second surface.

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Eradication of Screw-Worms through Release of Sterilized Males

Although the sterilizing effect of ionizing radiations has been known for years, it is only recently that entomologists have attempted to take advantage of the phenomenon for insect control. Knipling (*1*) has theorized on the effects of releasing sterilized males among a normal insect population. In 1947, on a visit to the Kerrville, Tex., laboratory, he proposed investigaitons on the mating habits of the screw-worm, *Callitroga hominivorax* (Cqrl.), and experiments with sterilized males. In such experiments Bushland and Hopkins (*2*) found that screw-worms were easily sterilized by exposing pupae to x-rays or gamma rays. They showed that under laboratory conditions male screw-worms mated repeatedly but females only once. If a female mated with a sterilized male it did not mate again and laid eggs that did not hatch. When mixed populations of normal and sterilized insects were observed in cages, the sterilized and normal males competed about equally for mates.

The U.S. Department of Agriculture conducted field tests with sterilized screw-worms in Florida from 1951 to 1953. Laboratory-reared irradiated males were found to mate with females of the normal population and to cause them to lay nonviable eggs. Continued releases of sterilized males greatly reduced the number of insects in nature, but a conclusive eradication experiment could not be made because of lack of a suitably isolated population of normal flies in Florida.

In 1954 an experiment was conducted on the island of Curaçao, which is beyond the flight range of screw-worms from the mainland of South America. On this island screw-worms were abundant and active throughout the year. The experiment was conducted by the Entomology Research Branch, USDA, in cooperation with the Veterinary Service of the Government of the Netherlands Antilles (Baumhover *et al.*, *3*). The work was conducted by two teams. A. H. Baumhover and W. D. New of the USDA branch, with B. A. Bitter of the Netherlands Antilles Veterinary Service, released sterilized flies on the island and made observations on the effects of the releases. At the branch's Orlando, Fla., laboratory A. J. Graham, D. E. Hopkins, and F. H. Dudley reared and sterilized screw-worms by irradiating 5-day-old pupae with 7500 r of gamma rays from cobalt-60, using the source described by Darden *et al.* (*4*). Immediately after irradiation the pupae were shipped by air freight to Curaçao, where the flies emerged and were distributed by airplane.

The density of the screw-worm population on Curaçao was estimated from the number of egg masses deposited on wounded goats held in pens suitably distributed over the island. In March, prior to the release of sterilized flies, native screw-worms deposited a total of 133 egg masses the first week and 155 the second week at 10 goat pens. All the egg masses were fertile. A weekly collection of 15 egg masses per goat pen represents a high population. This rate of oviposition was seldom equaled in any experiments in Florida.

Sterilized flies were released at the rate of approximately 100 males and 100 females (incapable of oviposition) per square mile each week over the 170-mi² island. Some of the released males mated with native females, for 15 percent of the egg masses deposited by native flies failed to hatch, but the percentage of sterile matings was not sufficient to reduce the population, because screw-worms increased during the release period. In May, after 7 wk of releases, 200 egg masses were collected, and after another week the collection was 240 egg masses.

During the next few weeks a lack of rainfall made conditions less favorable for screw-worms, and the number of egg masses deposited on the goats declined. After 1 July rains were frequent and the weather favored screw-worm increase. From 12 July to 8 Aug. half of the island was treated with sterilized flies at the rate of 100 males per square mile, and the other half at about 400 per square mile each week. The lower release rate caused approximately 31-percent sterility of egg masses, and the higher rate 49 percent.

Investigations up to this time were designed to determine the best method of release and the rate of release that would most likely lead to elimination of the insect. The rate decided upon was approximately 400 males per square mile each week over the entire island, although the number varied because of difficulties in rearing. The egg masses on the wounded goats were counted daily.

The releases during the first 4 wk, which averaged less than 400 per square mile each week, caused about 70-percent sterility. This rate of sterility caused a marked decline in the number of insects in the subsequent generation. This population depression in turn resulted in a higher ratio of sterile to fertile flies during the next few weeks. The percentage of sterile egg masses increased as the total number of egg masses declined.

Only two egg masses were collected after 3 Oct. One nonviable mass was collected on 4 Nov. and another on 11 Nov. The goat pens were maintained through 6 Jan. 1955, in order to be certain of eradication, but no more egg masses were observed. Releases of sterilized flies had been continued without interruption all this time but were discontinued when goat-pen records were stopped.

The U.S. Department of Agriculture personnel came home on 10 Jan., but Bitter continues to seek evidence of screw-worm activity on the island. From 1 Oct. 1954 to 1 July 1955, he had found no cases of screw-worms in the domestic animals on the island.

Under weather conditions prevailing on Curaçao the average time for a complete life-cycle should be about 4 wk. Most of the adult flies released would die of old age in about 3 wk. Because 9 mo have elapsed since the last evidence of normal fly activity, it appears that screw-worms have been eradicated.

The immediate significance of the Curaçao experiment is that it lends sup-

port to the theory that screw-worms might be eradicated from Florida through the use of sterilized flies. Screw-worms did not exist in the Southeast until they were introduced through shipment of infested livestock about 1933. In normal winters the insects survive only in peninsular Florida. If the overwintering population could be extirpated, the Southeast might be kept free of an insect that annually does millions of dollars' worth of damage to livestock in that region.

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14 April 1955

New Hemoglobin in Normal Adult Blood

Occasional reports have appeared suggesting the presence of small components other than normal adult hemoglobin in hemolyzates from normal human red blood cells (*1–3*). These have generally been considered nonpigmented proteins (*1*), but the technique of electrophoresis in free solution employed did not provide a definitive conclusion. The present paper is concerned, primarily, with the finding of a hemoglobin other than the main hemoglobin A, which has different electrophoretic properties, and is consistently found in normal adult blood in small amounts.

Zone electrophoresis in a starch slab covered with polyethylene sheeting by procedures described previously (*4*) permitted clear-cut separation in barbital buffer *p*H 8.6 $\Gamma/_2$ 0.05 or 0.1 of hemoglobin A from a slower migrating colored component. The hemoglobin solutions were prepared from oxalate or heparin blood by the method of Drabkin (*5*) but without employing $AlCl_3$. These were usually converted to carbonmonoxyhemoglobin and 0.4 ml of a 5- to 10-percent crystal-clear solution applied to a thin slit in the starch slab.

Figures 1*a*, *c* and 2*a* illustrate photographs taken with transmitted light on orthochromatic film of the separated red components of the blood from three different normal young adults. A component is clearly visible between the origin and the main hemoglobin-A spot.

It was possible to isolate this material from the starch block in preparative experiments in which 15 ml of dialyzed hemoglobin solution at 8-percent concentration was applied in long slits. Figure 2*b* illustrates one fraction isolated by displacement filtration (*4*) and concentrated by ultrafiltration. It is essentially free of hemoglobin A. The absorption curve in the visible region for this component was the same as that for hemoglobin A. No significant differences were found in the ultraviolet spectrum (*8*). The component was found, regardless of whether oxyhemoglobin, carbonmonoxyhemoglobin, or uncombined ferrohemoglobin in the presence of dithionite ions was employed. Hemoglobin A isolated free of this material did not give rise to this component, despite various harsh procedures. In the ultracentrifuge it showed an S rate indistinguishable from hemoglobin A. Comparison of this component with the known abnormal hemoglobins indicated that it showed a mobility in various buffers similar to that of hemoglobin E (*6*).

Figure 1*b* shows dilute hemoglobin E and A from a patient with hemoglobin E trait (*7*) separated on the same slab with the hemoglobin from two normal individuals. The unknown component in normal blood definitely migrated faster than hemoglobin C and more slowly than hemoglobin S (Fig. 2*d*). Electrophoresis in free solution (*8*) in barbital buffer *p*H 8.6 $\Gamma/_2$ 0.05 also demonstrated this component when a hemoglobin concentration of 3 percent or more was employed. The mobility calculated from the descending pattern was -1.94×10^{-5} compared with -3.48×10^{-5} for the main A component. In phosphate buffer *p*H 6.5, $\Gamma/_2$ 0.05 it also resembled hemoglobin E very closely, migrating to the cathode just ahead of hemoglobin A. Quantitative analyses of this slow component in the blood of 26 individuals, including normal persons and patients with a variety of chronic diseases, indicated a mean value of 2.6 percent of the total hemoglobin with a range of 1.8 to 3.5 percent.

Normal adult blood showed, in addition, small amounts of hemoglobin migrating faster than hemoglobin A in barbital buffer. This heterogeneous fraction is partially visible as an asymmetrical projection from hemoglobin A in Fig. 1*a*, *c*. It could also be isolated and concentrated and, upon repeated separation, always showed the same rapid mobility (Fig. 2*c*).

The slow component was a more clearly definable entity, differing markedly from hemoglobin A in respect to mobility. It was found in the blood of all normal individuals and patients with a variety of anemias. The only exception was the blood of newborn infants with predominantly fetal hemoglobin; in these cases it was either absent or greatly reduced. Increased levels were encountered in patients with thalassemia minor but not in thalassemia major when considerable fetal hemoglobin was present. It probably is identical with the small component noted by Singer and associates (*9*) in thalassemia blood and not identified previously as a hemoglobin.

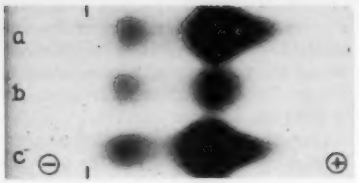

Fig. 1. Red pigments from normal red blood cells (*a* and *c*) and from E trait cells (*b*) separated on a starch block by electrophoresis in barbital buffer *p*H 8.6, $\Gamma/_2$ 0.05. The lines indicate the site of application.

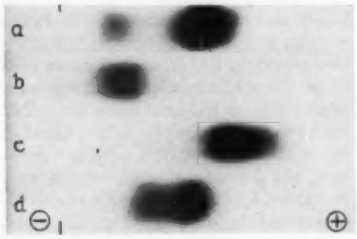

Fig. 2. Separation of four different hemoglobin preparations on the same starch block. (*a*) Hemoglobins from normal red blood cells. (*b*) Slow component isolated from normal hemoglobins. (*c*) Fast components isolated from normal hemoglobins. (*d*) Hemoglobins from blood of a patient with sickle cell trait.

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Book Reviews

Analysis of Development. Benjamin H. Willier, Paul A. Weiss, and Victor Hamburger, Eds. Saunders, Philadelphia–London, 1955. xii + 735 pp. Illus. $15.

Between 1933 and 1940 a group of embryologists constantly sat on the sands of Cape Cod discussing the mysteries of morphogenesis and the interpretation of experiments old and new. In the fullness of time, their excogitations led to the volume now before us—a wholly admirable treatment of the broad field of experimental morphology and developmental physiology and biochemistry. It is essentially a statement of the present position in a region where events are moving very rapidly.

Perhaps the chief contribution is the discussion of dependent differentiation (induction) in amphibians (Holtfreter and Hamburger), and it is interesting to see that the advance of the subject has obliged a return to the stricter biochemical conceptions of an earlier phase. Unfortunately, the purely mesodermal inductor of Toivonen was too late for inclusion.

Although space does not permit even the mention of all the contributors, it may be said that this paper is preceded by excellent articles on nucleus and cytoplasm (Fankhauser, Stern, Tyler), colloidal organization and submicroscopic morphology (Schmitt), and a stimulating sketch of the history of experimental embryology (Oppenheimer).

There follow contributions on differentiation mechanisms in other kinds of animals (Rudnick, Watterson, Bodenstein) and on the differentiation of particular organs in vertebrates (for example, Weiss, Twitty, Yntema, Rawles).

Next comes a thoughtful account of energy exchange and enzyme development during embryogenesis by Boell, who gives the best summary for many years of the vexed question of the sources of energy used by embryos during their ontogenies. The interesting study of the genesis of immunological properties (Tyler) prompts the suggestion that it might have been worth while to organize at least some of the material of the book in a framework less orthodox than that actually employed—for instance, to group together under one head all phenomena concerned with the experimental disaggregation and aggregation of living cells, tissues, and germ-layers, their mutual compatibilities and interactions. Finally, we have the ontogeny of endocrine correlation (Willier) and size-determination (Berrill), and the book ends with papers on regeneration and teratology.

The volume seems remarkably free from misprints, although editorial control over the texts and conventions shows some imperfections. Although most of the illustrations are exceptionally clear and good (for example, in the papers of Schour on teeth and Etkin on metamorphosis), one regrets that such valuable contributions as those of Bodenstein on insects and Twitty on eyes have no pictures at all. But for the most part this volume has done all that teamwork can do and will be accepted throughout the world as an outstanding justification of what can be done just by sitting on the sand.

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University Physics. Francis Weston Sears and Mark W. Zemansky. Addison-Wesley, Cambridge, Mass., complete ed. (ed. 2, based on Sears' 3-vol. work, *Principles of Physics*, with supplementary problems), 1955. viii + 1031 pp. Illus. + plates. $8.50.

This is the king-size Sears and Zemansky, 17 percent longer than its 1949 predecessor, and greatly modified in appearance and content. Not only does it come in the red jacket characteristic of "king-size," but a side-by-side comparison of the new book with the old one leaves the favorable impression that the authors have done a thorough revision, keeping in mind the fact that the book is primarily for instruction. They have been careful to rearrange ideas for better impact on the student, and the general attractiveness and teachableness of the book are enhanced by improved draftsmanship of countless figures. There is a liveliness about the new figures that is impressive and gives the book a completely new look.

Many parts are rewritten or recast, and there has been no slavish holding to old pages. Where the calculus is used, much care has been exercised in making the ideas behind this approach still clearer to the student. One major change occurs in the introduction of completely new problems for each chapter. However, the old problems have been retained in an appendix. Answers to all odd-numbered problems of both sets are given. This appendix alone contributes the greatest change in length of the book, accounting for approximately half of the 154 pages added. The largest other changes occur in electricity (30 new pages) and in optics (21 new pages). Many of the ray diagrams for optical systems are now produced in white against black, a device used many years ago but not often used in recent textbooks.

Some 18 new topics and extensions of treatment are enumerated by the authors as additions to subject matter. Many of these are just as "classical" as other materials already included; a few are newer. It is interesting to note, for example, that the engineering problem of architectural acoustics has given place to the treatment of musical scales! The effect of these additions, and of the book as a whole, is to make a complete and encyclopedic volume. Every author of a textbook must decide how closely to make his book like tomorrow's newspaper or next month's magazine. Sears and Zemansky have written a solid textbook, not a newspaper; but, because the emphasis is steadily upon principles and their application, the budding engineer and scientist should acquire from the study of this textbook an ability to read next month's magazine with understanding. In a world that needs technically trained persons, those who master the contents of this book should find strong positions.

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Pathology of the Dog and Cat. The genitourinary system with clinical considerations. Frank Bloom. American Veterinary Publications, Evanston, Ill., 1954. xv + 463 pp. Illus. $12. ($12.50 outside U.S.A.)

This book presents a very thorough coverage of the special pathology of the genitourinary system of the dog and cat. As with most first editions, there are obvious faults, but they are far overshadowed by the wealth of information provided, its presentation and organization, and the excellent illustrations.

The contents are presented in three sections or chapters; the urinary system, the male genital system, and the female genital system including the mammary gland. Fundamentally there is a brief

description of normal anatomy followed by a discussion of the various pathologic entities, their incidence, possible etiologic factors, the clinical pathology, and clinical correlations. The latter should prove of particular value to veterinarians in practice.

The first section, which deals with the urinary system, includes discussions on the kidney, urolithiasis, renal pelvis and ureter, the urinary bladder, and the urethra. In my opinion this section is particularly excellent.

The second section concerns the male genital system and includes discussions on hermaphrodism and pseudohermaphrodisms, the testis and epididymis, the spermatic cord, vas deferens, scrotum, penis, and prostate. The organization and coverage of this section is adequate and complete.

The third chapter, or section, deals with the female genital system and includes a discussion of the sexual cycle, the vulva, vagina, uterus, pregnancy and the placenta, the Fallopian tubes, ovary and mammary gland. Like the first two sections, this one is very complete.

The faults of the text are really minor and include a poor main title and a very poor index. The subtitle should be incorporated into the title of the text, which coverwise is misleading. There is a wealth of good information in the text which, unfortunately, cannot be found in the index. For example, there is an ample discussion of blood and urine alterations throughout the text, yet neither subject appears in the index.

In my opinion this book is a definite contribution and can be recommended highly to the veterinary profession as well as to those scientists who utilize the dog or cat as an experimental animal.

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Higher Transcendental Functions. vol. III. Based in part on notes left by Harry Bateman. Bateman Project Staff, A. Erdélyi, Ed. McGraw-Hill, New York–London, 1955. xviii + 292 pp. $6.50.

This is the last of the five volumes produced by the Bateman Manuscript Project [see *Science* **120**, 302 (1954); **121**, 464 (1955)]. Sections on Lamé functions, Mathieu functions, spheroidal and ellipsoidal wave functions, and miscellaneous functions (such as Mittag-Leffler's *E*-functions and the "higher trigonometric functions") follow the pattern of the earlier volumes: a survey of important formulas with full references to the specialized literature for proofs and further details.

There are also three chapters of a different character: an introduction to automorphic functions and a chapter on number-theoretical functions, both characterized by the editor as "frankly experimental"; and a chapter on generating functions. The first is a concise elementary survey, intended as background for some explicit examples. In the second, little unity or coherence is possible, but there is probably no single book on number theory in which all the information in this chapter appears. The chapter on generating functions (in the sense of functions whose power series have an interesting set of functions as coefficients) is a collection of results linked by an accidental similarity of form. Examples are given to indicate various ways in which generating functions are used. Unfortunately there is no way of predicting whether a given set of functions will have a useful generating function. However, anyone confronted with the power series of a complicated function containing a parameter will do well to look here to see whether the coefficients have already been investigated.

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World Outside My Door. Olive Bown Goin. Macmillan, New York, 1955. vi + 184 pp. Illus. $3.50.

Mrs. Goin is first and foremost a housewife, the publisher tells us; her household consists of her husband, an associate professor of biology at the University of Florida, two children, and two cats. Mrs. Goin's training as a biologist (mammalogist) and her obvious ability as a naturalist, combined with an artist's enjoyment of color and movement and a warm outlook on life, make her book alive, enjoyable, and, where she permits her biological training to dominate, most accurate.

A half-acre of backyard in a southern city becomes a Fabresque field for observation. *Bipalium* lives with marsh peepers, turtles, rain frogs, cardinals, and rabbits—all in balance with four human beings.

For those who prefer *Elaphe obsoleta quadrivittata* to four-lined chicken snake, there is an appendix listing some 70 species of vertebrates she has observed.

Mrs. Goin apparently believes that the naturalist's field is all life, and this total view blends her backyard into the community that naturalists have fashioned wherever they have tried to describe microorganisms (Leidy) or the animals of the African veldt (Akeley). So a rain frog's habits are projected into its evolutionary past, the spade-foot's activity is related to temperature, and the peck order of birds is noted and pondered.

Naturalists, young and old—and those who should be naturalists—should seek Mrs. Goin's company, if in no other way than through her book.

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Biochemistry of Nitrogen. A collection of papers on biochemistry of nitrogen and related subjects. Dedicated to Artturi Ilmari Virtanen. N. J. Toivonen, E. Tommila, *et al.*, Eds. Annales, Series II, Chemica. Suomalainen Tiedeakatemia, Helsinki, 1955. 535 pp. Illus. + plates. $12.

This Festschrift contains 48 papers from 14 countries on the biochemistry of nitrogen and related subjects. It is dedicated to Nobel laureate Artturi Ilmari Virtanen on the occasion of his 60th birthday. Most of the articles are in English, the others are in German and French.

The scope of the subjects represented reflects the range of interests and versatility of Virtanen. Thus there are articles on nitrogen fixation, reduction of nitrate, the biochemistry of nitrogen-deficient microorganisms, oxidation of amino acids by mitochondria, protein metabolism in cell nuclei, amino acids in protein-rich and protein-poor *Rhodotorula gracilis*, protein and nucleic acid contents of developing *Chlorella*, antibiotics and nitrogen excretion by microorganisms, inhibitory effect of Swedish ropy milk on fungi, symbiosis in bacterial biosynthesis, mutations and adaptations in bacteria, and free amino acids of the pea plant.

There are discussions concerning the effect of irradiation on the formation of hemoglobin, reversible splitting of hemoglobin, the prosthetic groups of cytochrome oxidase and cytochrome *a*, polymers of aminosugars, the significance of macromolecules, combination of phytic acid with protein, studies on the metabolism of citrate, tyrosine and tryptophan, and isotopically labeled fructose, milk proteins in nutrition, electronegativity (Pauling), magnesium diabetes, reductone, chaconin, and γ-aminobutyrate.

There are descriptions of column chromatography of proteins, immunoelectrophoresis, the enzymatic syntheses of adenosine, and chemical syntheses of nucleotide coenzymes, a pyridine nucleoside, peptides, and isotopically labeled kynurenine. Two phases of photosynthesis are described by Calvin and by Warburg, both with associates. Enzymes discussed include pancreatic lipase, hy-

droxylamine reductase, yeast invertase, phosphotransferases, citrulline phosphorylase, and two transaminases.

Jorgensen has discussed a broadened concept of buffers based on Brønsted's acid-base definition. Special mention is also to be made of an article by F. C. Stewart and associates on "Nitrogenous components in plants: recent knowledge derived from paper partition chromatography." This comprehensive review includes diagrams and extensive tables of value to the investigator; R_F values for 160 nitrogenous substances are presented.

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Radioisotope Conference, 1954. vol. II, *Physical Sciences and Industrial Applications.* Proc. Second Conference, Oxford, 19–23, July. J. E. Johnston, Ed. Academic Press, New York; Butterworths, London, 1954. ix + 223 pp. Illus. $7.50; vols. I and II, $16.

This volume is a collection of 24 journal-style papers that were presented at the Radioisotope Conference held at Oxford in July 1954. Almost without exception, these papers will be found to be both interesting and informative to any scientist or engineer who is interested in the applications of radioisotopes to industrial and research problems. However, although a small volume such as this might have been enough 8 years ago to have provided a comprehensive survey of radioisotope applications, for the year 1954 it is only a very limited collection of isolated examples of such applications. None of the papers is of a review type, and most of the work had already been described, or was subsequently described, in the usual journal literature.

Thirteen of the papers deal with the application of radioisotopes to industrial problems. Some of the more generally interesting examples of these papers are (i) determinations of the thicknesses of metal sheets by selectively measuring back-scattered gamma radiation, (ii) the use of ionized air to overcome electrostatic-charge hazards in hospitals and industry, (iii) determinations of the expected life of cutting tools from the rate of disappearance of radioisotopes formed by neutron irradiation, (iv) use of gamma radiation for the sterilization and pasteurization of foods, and (v) the use of radioisotopes in industrial radiography. However, as an example of the noncomprehensive nature of the collection, the fact may be cited that there is not a single paper dealing with any phase of the now very great use of radioisotopes in petroleum exploration and refining.

Eleven of the papers may be regarded as dealing with the use of radioisotopes in chemical and physical research. Outstanding papers among this collection are (i) use of C^{14} in a study of the Wagner-Meerwein rearrangement involving 1,2,2-triphenylethanol and its derivatives, (ii) the application of the catalytic isomerization of cycloalkanes to the synthesis of aromatic compounds randomly labeled with C^{14} in the ring, (iii) a method for measuring the deuterium content of water by the neutrons produced from gamma irradiation of the water, (iv) gas counting (as acetylene in proportional counters) of natural C^{14}, and (v) liquid-scintillation counting of low specific activity C^{14} (as acetylene in toluene solution).

The Radioisotope Conference was undoubtedly very successful, and many of the papers presented there are highly interesting. However, the price for this very limited group of papers is entirely too high to permit my recommending it to individual purchasers.

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Outlines of Enzyme Chemistry. J. B. Neilands and Paul K. Stumpf. Wiley, New York; Chapman & Hall, London, 1955. x + 315 pp. Illus. $6.50.

Enzymology is a rather young and rapidly growing branch of general biochemistry. The beginning student is confronted with a confusing journal literature and several highly specialized books on the properties of enzymes. Moreover, the language in enzymology has become so full of jargon that the beginning student often feels excluded from this field.

Refreshing efforts to change this situation were recently made by E. Baldwin in his stimulating treatise on the *Dynamic Aspects of Biochemistry* and by J. S. Fruton and S. Simmonds in their lucid presentation of *General Biochemistry.* These books have exerted a very stimulating influence on many senior college and graduate students by enabling them to grasp the significance of enzyme studies and subsequently to read more intelligently the complex and specialized literature.

The book *Outlines of Enzyme Chemistry* will undoubtedly contribute further to these efforts to provide a more adequate background for the beginning enzymologist. The volume is divided into four parts. The first two parts, which comprise more than half of the book, are devoted to elementary physical chemical aspects of enzymology, including brief chapters on isolation methods and characterization of proteins. The third part deals with specific coenzymes and enzymes. It includes several tables and a listing of enzymes. The fourth part is entitled "Metabolic patterns" and deals with some selected processes of carbohydrate metabolism and fatty acid oxidation. The book closes with a short but excellent chapter by Roger Y. Stanier on the synthesis of enzymes.

The 24 chapters of the book are well written and are comparatively free of major errors. However, the presentation of the material is somewhat unbalanced with respect to the background of knowledge required of the reader. Since, in the first half of the book very elementary aspects of physical chemistry, such as the ionization of weak acids and bases, are discussed rather extensively, the second half of the book appears very condensed by comparison. For example, alcoholic fermentation is presented by one figure, two tables, and a little more than one page of text. No mention is made of many important and interesting enzyme mechanisms of the urea cycle and nucleic acid and amino acid metabolism.

These and other omissions detract from the value of the book for the beginning student. In spite of these shortcomings, which can be avoided in later editions, the volume represents a very useful contribution to the teaching of enzymology. Taken as a whole, this book may be said to fulfill the aim of the authors to introduce senior undergraduate and beginning graduate students to the general subject of enzymology.

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The Theory of Cohesion. An outline of the cohesive properties of electrons in atoms, molecules, and crystals. M. A. Jaswon. Interscience, New York; Pergamon, London, 1954. viii + 245 pp. Illus. $5.75.

This is the second volume of a new series of monographs on metal physics and physical metallurgy edited by G. V. Raynor. Jaswon's purpose is to convey the mathematical development of the theory of cohesion to readers who are already acquainted with the qualitative aspects of the subject. The first six chapters review the basic ideas of wave mechanics and their application to the study of the helium atom, the hydrogen molecule, and the theory of molecular orbitals. This provides the groundwork for the latter part of the book, in which the theory of metals, the application of the cellular approximation, and covalent structures are discussed.

Jaswon does not cover as wide a field as the title suggests. The illustrative ex-

amples have been chosen almost entirely from the field of metals and alloys; ionic crystals are not considered at all, and the chapter on covalent binding is really too brief to be more than the barest outline of a treatment of molecules. These omissions, however, will not prevent the book from being useful to workers in fields other than metal physics, for it accomplishes successfully its major aim of providing a survey of the theory at an intermediate level. This has been done in a clear and compact manner; the mathematics has been kept as simple as possible; and the author has taken pains to stress the nature of the approximations that are such an unavoidable prerequisite for progress in this area. This monograph fills a definite gap in the literature between advanced and elementary accounts of the subject; with its emphasis on fundamentals, this should be a helpful and useful book to a wide range of readers.

The author and subject indexes are adequate, and the printing and production are good; unfortunately one cannot say the same for the proofreading; trivial errors abound, a figure (8.2) has been inverted, and a section of six pages purported to be on "The oxygen molecule" deals in fact with H_2O!

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Substances Naturelles de Synthèse. Préparations et Méthodes de Laboratoire. vol. X, Comportant la Table Récapitulative des Volumes VI à X. Léon Velluz, Ed. Masson, Paris, 1954. 201 pp. Illus.

This series, begun in 1951 and completed with the present volume, has given methods for making about 80 compounds of significance in nature. The editor's selection has not unduly overlapped comparable collections of recipes published elsewhere, mainly because the latter deal with more commonplace compounds. Earlier volumes in the present series have included descriptions of the synthesis from easily accessible materials of, for example, adenosine, chloramphenicol, hydrocortisone, lyxoflavine, phenylalanine, and thyroxin.

The present volume runs true to form in giving instructions for making DL-arginine, vitamin A_1, L-carnosine, β-carotene, ergothioneine, D-glucosamine, DL-penicillamine, and retinene. It also expatiates typically on these subjects: the text includes descriptions of the compounds, expositions on the synthesis of peptides and compounds containing isoprene chains (with recipes for making intermediates useful for the former purpose), and incidental notes on guanidine derivatives, the haloform reaction, Michael-type additions, and the Lobry de Bruyn-van Eckenstein rearrangement. The two expositions are accompanied by useful tables summarizing the application of the methods mentioned. The book ends less aptly by tabulating some properties of common solvents. Instructions for resolving the two DL-amino acids are not given.

Unfortunately, the discursiveness of the present volume bloats it with excessive detail. As either a textbook or a work of reference, it is overloaded with the minutiae of the syntheses, which are translated almost word for word from easily accessible reports in the literature. A few deft pricks from the editorial poniard could have deflated this otiose repetition while sparing the essential fabric of summaries and references; if the free space had then been filled with appraisals of the methods used, the book would have benefited both in readability and as a source of information.

Notwithstanding these shortcomings, this volume is up-to-date and, except for mistakes in the formulas for bufotoxin (p. 6) and anserine (p. 35) and misleading cyclic formulas for the sugars, it seems clear and accurate. It is a pity that, although it is concocted from the elements of recent successes in synthesis, it cannot be recommended either as a steady *vin ordinaire* to sustain the skills of the laboratory or as the quintessential *digestif* to clear and inspire minds surfeited with the rich bulk of chemical literature.

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Variational Principles in Dynamics and Quantum Theory. Wolfgang Yourgrau and Stanley Mandelstam. Pitman, London, 1955 (U.S. distr.: Pitman, New York). viii + 155 pp. Illus. $5.50.

This short booklet is a semihistorical account of variational principles in classical mechanics and in early wave mechanics. As far as the subject matter is concerned, it includes in classical physics the Hamiltonian formalism and Hamilton-Jacobi theory but not Poisson brackets. In quantum mechanics, there is no discussion of the work of Feynman, Schwinger, or Peierls, or of the possibility of a representation-invariant variational principle. To this extent, the book does not appear to be a useful introduction to the variational principles as they appear in the current literature. For a working knowledge of classical dynamics, at least the introduction of Poisson brackets would have been necessary.

The principal purpose of the authors appears to have been an inquiry into the philosophic significance of variational principles. They show that historically many of the discoverers were motivated by metaphysical considerations. Planck (to whose memory the book is dedicated) attempted to discuss causality in physics in terms of the principle of least action. The authors, in a concluding paragraph of perhaps 20 pages, discuss both positivistic and idealistic interpretations of variational principles and appear to steer a middle course between these extremes. It appears that the discussion is not as penetrating as one might wish.

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New Books

Metals Reference Book. vols. I and II. Colin J. Smithells. Interscience, New York; Butterworths, London, ed. 2, 1955. 965 pp. $25 per set.

Adventuring with Beebe. William Beebe. Duell, Sloan & Pearce, New York; Little, Brown, Boston, 1955. 283 pp. $4.50.

Logique et dynamique du peuplement végétal. Phytogéographie, phytosociologie, biosystématique, applications agronomiques. M. Guinochet. Masson, Paris, 1955. 140 pp.

William Herschel. Explorer of the heavens. J. B. Sidgwick. Faber & Faber, London; Macmillan, New York, 1955. 228 pp. $2.50.

Engineering Metallurgy. L. F. Mondolfo and Otto Zmeskal. McGraw-Hill, New York–London, 1955. 397 pp. $7.50.

The Pharmacopeia of the United States of America. U.S. Pharmacopeial Convention, Inc., New York, rev. ed. 15, 1955. 1178 pp. $10.

Our Backward Children. Karl F. Heiser. Norton, New York, 1955. 240 pp. $3.75.

Neurochemistry. The chemical dynamics of brain and nerve. K. A. C. Elliott, Irvine H. Page, J. H. Quastel, Eds. Thomas, Springfield, Ill., 1955. 900 pp. $19.50.

Discoveries and Inventions of the 20th Century. J. G. Crowther. Dutton, New York, rev. ed. 4, 1955. 432 pp. $6.

Quantum Mechanics. International Ser. in Pure and Applied Physics. Leonard I. Schiff. McGraw-Hill, New York–London, ed. 2, 1955. 417 pp. $6.50.

Plant Taxonomy. Earl L. Core. Prentice-Hall, New York, 1955. 459 pp. $7.50.

Grundriss der Gefriertrocknung. Karlheinz Neumann. Musterschmidt, Berlin, ed. 2, 1955. 256 pp. DM. 24.

The Caves Beyond. The story of the Floyd Collins' Crystal Cave exploration. Joe Lawrence, Jr., and Roger W. Brucker. Funk & Wagnalls, New York, 1955. 283 pp. $4.75.

Radio Astronomy. International Monogr. on Radio. J. L. Pawsey and R. N. Bracewell. Oxford Univ. Press, New York–London, 1955. 361 pp. $8.80.

Le Poumon. Stuctures et mécanismes à l'état normal et pathologique. A. Policard. Masson, Paris, 1955. 262 pp. F. 1500.

Scientific Meetings

Color Mixture Functions To Be Modified

A change in the basis for evaluating light and color is in the offing as a result of the reports made at the Zurich sessions of the International Commission on Illumination (CIE), 13-22 June. The color mixture functions that have defined the standard observer for colorimetry since 1931 and were based on the use of a small field (2 deg) will probably be superseded by new functions obtained with a field subtending an angle of 10 deg. W. S. Stiles (National Physical Laboratory, England) presented data obtained with the large field to supplement the secretariat report of D. B. Judd (National Bureau of Standards, U.S.A.). The 1931 $\bar{y}_\lambda$ function, which is exactly the relative photopic luminous efficiency curve adopted by the CIE in 1924 and has been used internationally for the photometry of sources differing in spectral characteristics, will probably be changed for colorimetric purposes. This will leave for decision the question of whether there should be adopted for photometry identically the same function or a curve as similar as possible to the currently used curve, so that the photometric values assigned to various types of lamps, such as vacuum and gas-filled incandescent lamps and electric-discharge lamps, will not have to be changed importantly.

Based on an analysis of the signal-light problem in a secretariat report presented by F. C. Breckenridge (National Bureau of Standards, U.S.A.), recommendations on 3-color, 4-color, 5-color, and 6-color signal systems were adopted as being applicable to signal lights used for all forms of transportation. Plans were made to acquire data on the recognition and discrimination of signal lights in the blue-green-white-purple region and also on the recognition of surface colors and the effect on them of age and dirt.

At the Zurich meeting, work that has been in progress on the development of a comprehensive International Lighting Vocabulary in English, French, and German was brought to a practical climax. It is now expected that the vocabulary containing the definitions of more than 500 terms in the three languages will be available in printed form within a year.

Although the working group of experts on automobile lighting was not able to arrive at an agreement on the universal use of the same type of headlamps, progress was made toward the objective of attaining mechanical interchangeability, and there still exists the possibility of international standardization of headlights as well as of signal lights, reflex reflectors, and tail lamps.

At the Zurich sessions of the CIE 35 secretariat reports and 34 papers were presented.

L. E. Barbrow, National Bureau of Standards, Washington 25, D.C. is the secretary of the U.S. National Committee of CIE and requests for more details of the Zurich sessions should be addressed to him.

L. E. Barbrow

Meeting Notes

■ The 6th annual National Noise Abatement symposium will be held 20–21 Oct. at the Armour Research Foundation of Illinois Institute of Technology, Chicago. Robert W. Benson, supervisor in the foundation's physics research department, has been appointed chairman of the symposium, which is sponsored by the foundation and several other organizations. The purpose of the meeting is to bring together persons interested in the effects, measurement, and control of noise.

■ During the 10th annual Instrument-Automation Conference and Exhibit, which will take place in Los Angeles, 10–12 Sept., the Instrument Society of America will present its 1955 Maintenance Clinic. Twenty-four subjects will be covered. Every student will have his choice of one of the three groups of eight subjects each.

The material will be presented by personnel from the training departments of various factories. This program will be of benefit to men charged with responsibility for maintaining industrial process- and test-control equipment.

In each 2-hr period a particular type of instrument will be described, and its operation will be demonstrated. Suggestions will then be made on the methods of locating causes of improper operation. The student will also be instructed in the adjustments that must be made to restore the instrument to operation. Following this instruction, the students will be allowed to apply their newly acquired knowledge by servicing instruments that have been deliberately disabled.

The clinic will be held in Founders Hall of the University of Southern California in Los Angeles. Registration fee is $5 for members of organizations participating in the ISA conference (ASME, AIEE, IRE, and SCMA). The fee for others is $7.50. Certificates will be presented at the closing sessions to all who complete the schedule. Schedules will be provided on request. To enroll, send registration fee to: ISA Instrument Maintenance Clinic, 1315 Allegheny Ave., Pittsburgh 33, Pa.

■ Arrangements are nearing completion for the American Heart Association's 31st annual meeting and 28th scientific session in New Orleans, 22–28 Oct. Nearly 350 papers have been submitted for presentation at the scientific sessions; this is more than twice the number received by the association for any previous sessions.

Although time will not permit presentation of more than one-quarter to one-third of these papers at New Orleans, arrangements have been made to publish abstracts of most of the papers as part of the proceedings of the scientific sessions. These proceedings will be included in the October issue of *Circulation*, the association's monthly journal.

The scientific sessions and the programs of the Council on Community Service and Education and of the Council on Rheumatic Fever and Congenital Heart Disease will be conducted at the New Orleans Municipal Auditorium, 22–24 Oct. Other events, including the annual meeting of the assembly, AHA governing body, will be held at the Jung Hotel.

The scientific program will consist of general morning sessions and concurrent afternoon sessions of specialized interest to members of the various sections and councils of the association, including the sections on clinical cardiology, cardiovascular surgery, circulation and basic science (jointly), and high blood pressure.

In addition, there will be a program on the prevention of rheumatic fever and the problems of cardiac children in the schools. This will be under the joint auspices of the Council on Rheumatic Fever and Congenital Heart Disease and the Council on Community Service and Education. The community service council will also offer a program encompassing rehabilitation and the relationship between body weight and heart disease.

Two special lectures have been scheduled: the Lewis A. Conner memorial

lecture on 22 Oct., and the George Brown memorial lecture on 23 Oct. The Conner lecture will be presented by George A. Perera, associate professor of medicine at Columbia University College of Physicians and Surgeons, who will speak on "Primary hypertension." George Burch, Henderson professor of medicine at Tulane University School of Medicine, will give the Brown lecture on the topic "Digital rheo-plethysmography."

Attendance at the scientific sessions is open to nonmembers for a registration fee. Medical students, interns, residents, research workers, and nurses will be welcome at the sessions without charge. Registration forms, which contain provisions for reserving hotel accommodations, can be obtained from local heart associations and from the American Heart Association, 44 E. 23 St., New York 10.

■ The first Symposium on Gas Dynamics, sponsored by the American Rocket Society and Northwestern University, will take place in Evanston, Ill., 22–24 Oct. The theme of the meeting will be aerothermochemstry. The papers to be presented will cover engineering research in this field, with extension to fluid dynamics, chemical kinetics, and thermodynamics.

The contributions are unclassified and should be of interest to all concerned with basic problems allied to rocket and jet propulsion as well as to high-speed combustion in general. The symposium was organized with the cooperation of the Office of Scientific Research, Air Research and Development Command.

Abstracts of the papers to be presented will be available at the time of registration. It is planned that the papers and pertinent discussions will be brought together after the symposium in a volume of proceedings. Correspondence should be addressed to Gas Dynamics Symposium, Northwestern Technological Institute, Evanston, Ill.

■ An international symposium on arteriosclerosis will be held in Minneapolis, Minn., 7–9 Sept., under the joint sponsorship of the University of Minnesota and the Minnesota Heart Association, an affiliate of the American Heart Association. Ancel Keys will serve as chairman of the symposium in which medical scientists from nine states, the District of Columbia, Canada, Germany, Italy, Sweden, the Union of South Africa, and the United Kingdom will participate.

The first morning of the symposium will be devoted to presentations on the research, public health, medical education, and insurance aspects of arteriosclerosis, as well as on the role of the American Heart Association and its affiliates and of the National Heart Institute in the campaign against arteriosclerosis. The symposium will then turn to specific studies, with more than 30 specialized papers scheduled for presentation.

E. Cowles Andrus of Baltimore, Md., and Irvine H. Page of Cleveland, Ohio, president and president-elect, respectively, of the AHA, will be participants, as will Louis N. Katz, of Chicago, and Paul D. White of Boston, past presidents of the association.

■ T. Dale Stewart, curator of physical anthropology at the Smithsonian Institution, and Mildred Trotter of Washington University, St. Louis, recently issued, with the assistance of a grant from the Wenner-Gren Foundation for Anthropological Research, a compilation of the major research papers published in the United States on the estimation of age from the skeleton. This publication will serve as a starting point for a seminar on human identification, 7–9 Sept., sponsored by the Smithsonian Institution, in which many of this country's leading physical anthropologists will take part.

However, skeletal determination of age will be only one of the subjects for discussion. Attention will also be given to identification problems arising from decomposition and disintegration of the body. Sometimes age, sex, race, stature, and body build must be estimated from poorly preserved or incomplete human remains.

Some identification data is highly reliable, some unreliable. Fingerprinting is fairly reliable, if previous fingerprint records exist for comparison. The claim that no two persons ever have precisely the same fingerprint pattern is probably justified, according to Stewart, but there are numerous other individual differences for which the same claim can be made: for example, the pattern of air sinuses in the mastoid bones is never precisely the same in two persons.

Both in Europe and the United States identification criteria have been developed by physical anthropologists, chiefly because of their interest in ancient and primitive peoples. But the same criteria can be applied just as well, and with considerable assurance, to man of today.

■ Plans for the North Central Conference on Biology Teaching at the University of Michigan's Biological Station, 19–30 Aug., are now completed, according to Richard L. Weaver, director of the conference. The five scientists who will guide the discussions on assigned topics are John S. Karling of Purdue University, "Plants and man"; Samuel T. Dana of the University of Michigan, "Conservation"; H. O. Goodman, Michigan State University, "Human inheritance"; Harry Fuller, University of Illinois, "Food supply of man"; and Robert Bowman of the University of Michigan, "Health and disease."

Ninety delegates have been selected for the conference from nominations by the steering committee, officers of NABT, and directors of national scientific organizations. The conference is supported by a grant from the National Science Foundation.

In addition to Weaver, the conference staff includes John Breukelman, who is chairman of the steering committee, and Richard Armacost, Paul Klinge, and Alfred Stockard. A few copies are still available of the report of the first conference, which was held at the University of Florida last summer. These can be obtained from Richard Weaver, Box 2073, Ann Arbor, Mich.

Erratum: The 10th International Congress of Entomology will take place in Montreal, 17–25 Aug. *1956*. The preliminary announcement that appeared in the 29 July issue failed to mention the year; *Science* regrets the omission.

Forthcoming Events

September

12–14. Soil Conservation Soc. of America, Green Lake, Wis. (H. W. Pritchard, Paramount Bldg., Des Moines, Ia.)

12–15. International College of Surgeons, 20th annual, Philadelphia, Pa. (K. A. Meyer, 1516 Lake Shore Dr., Chicago 10, Ill.)

12–16. Illuminating Engineering Soc., annual, Cleveland, Ohio. (A. D. Hinckley, 1860 Broadway, New York 23.)

12–16. Instrument Soc. of America, 10th annual, Los Angeles, Calif. (Fred Tabery, 3443 S. Hill St., Los Angeles.)

13–15. American Meteorological Soc., Asbury Park, N.J. (K. C. Spengler, 3 Joy St., Boston 8, Mass.)

14–16. American Assoc. of Clinical Chemists, 7th annual, Minneapolis, Minn. (M. M. Friedman, Lebanon Hospital, New York 57.)

14–16. Assoc. for Computing Machinery, annual, Philadelphia, Pa. (J. P. Nash, Digital Computer Lab., Univ. of Illinois, Urbana.)

14–16. IRE Professional Group on Nuclear Science, 2nd annual, Oak Ridge, Tenn. (H. E. Walchli, Oak Ridge National Lab., P.O. Box P, Y-12, Oak Ridge.)

15–16. Corrosion Symposium, Montreal, Canada. (Chemical Inst. of Canada, 18 Rideau St., Ottawa 2.)

15–17. International Soc. for the Study of Biological Rhythm, 5th conf., Stockholm, Sweden. (T. Petrén, Karolinska Institutet, Stockholm 60.)

16–17. American Psychiatric Assoc. Midwest Regional Research Conf., Galesburg, Ill. (L. H. Rudy, Galesburg State Research Hospital, Galesburg.)

(*Continued on page 296*)

Kodak reports to laboratories on:

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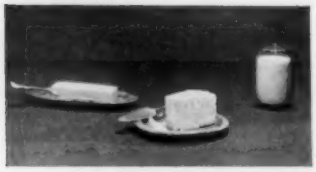
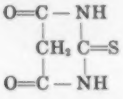
For Barbara



According to a charming tale, the great von Baeyer named barbituric acid for Barbara, a friend of his. Then someone came along and replaced one of its three ketonic oxygens with sulfur, creating 2-thiobarbituric acid.



Then someone else added 2-thiobarbituric acid to fructose and got a yellow precipitate. Then some medical school people obtained an entirely different orange-red precipitate by reacting 2-thiobarbituric acid with incubated brain tissue and proceeded to prove that the reaction was with a 3-carbon fragment of an oxidized double-bonded fatty acid moiety of the lecithin in the tissue. Then some dairy chemists conceived the idea that this property of 2-thiobarbituric acid might make a convenient test for oxidative deterioration in fats. Then some agricultural chemists worked out the details for using 2-thiobarbituric acid to find out objectively when cheddar cheese has gone bad. Or powdered whole milk or butter. Then we prepared a procedural abstract of their method to give away in order to help us sell our *2-Thiobarbituric Acid* (Eastman 660) at $2.25 for 25 grams.

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(*Continued from page 294*)

16–17. Calorimetry Conf., 10th annual, Minneapolis, Minn. (E. F. Westrum, Jr., Dept. of Chemistry, Univ. of Michigan, Ann Arbor.)

17–21. American College of Hospital Administrators, 21st annual, Atlantic City, N.J. (D. Conley, ACHA, 620 N. Michigan Ave., Chicago 11, Ill.)

19–23. Fédération Internationale Pharmaceutique, 16th general assembly, London, Eng. (D. F. Lewis, Secy., Organizing Committee, FIP, 17 Bloomsbury Sq., London W.C.1.)

20–23. American Roentgen Ray Soc., Chicago, Ill. (B. R. Young, Germantown Hospital, Philadelphia 44, Pa.)

20–26. World Medical Assoc., 2nd congress, Vienna, Austria. (L. H. Bauer, 345 E. 46 St., New York 17.)

22–23. Symposium on the Less Common Metals, London, Eng. (W. J. Felton, Institution of Mining and Metallurgy, Salisbury House, London, E.C.2.)

23–24. Symposium on the Biologic Effects of Microwaves, Rochester, Minn. (J. F. Herrick, Section of Biophysics, Mayo Clinic, Rochester.)

25–28. American Inst. of Chemical Engineers, Lake Placid, N.Y. (F. J. Van Antwerpen, AICE, 25 W. 45 St., New York.)

26–29. Assoc. of Iron and Steel Engineers, annual, Chicago, Ill. (Secretary, AISE, Empire Bldg., Pittsburgh 22, Pa.)

26–30. International Dairy Federation, annual, Bonn, Germany. (IDF, 154, rue Belliard, Brussels, Belgium.)

26–30. Atomic Industrial Forum and Trade Fair, Washington, D.C. (C. Robbins, 260 Madison Ave., New York 16.)

26–30. Colloquium on Deformation and Flow of Solids, Madrid, Spain. (H. L. Dryden, National Advisory Comm. for Aeronautics, Washington 25.)

26–1. Endocrine Soc., 7th annual postgraduate assembly, Indianapolis, Ind. (Postgraduate Office, Indiana Univ. School of Medicine, Indianapolis 7.)

27–1. International Symposium on Analogue Computers, Brussels, Belgium. (P. Germain, Institut de Physique Appliquée, Université Librede Bruxelles, Bruxelles.)

28–29. Industrial Electronics Conf., Detroit, Mich. (G. Ferrara, 8106 W. Nine Mile Rd., Oak Park 37, Mich.)

28–30. Mississippi Valley Medical Soc., St. Louis, Mo. (H. Swanberg, 209–224 W.C.U. Bldg., Quincy, Ill.)

29–1. International Soc. of Vegetative Neurology, 6th annual symposium, Strasbourg, France. (R. Fontaine, Univ. of Strasbourg Faculty of Medicine, Strasbourg.)

30. American Medical Writers' Assoc., St. Louis, Mo. (H. Swanberg, 209–224 W.C.U. Bldg., Quincy, Ill.)

30–1. Council for International Organizations of Medical Sciences, 3rd general, Paris, France. (J. F. Delafresnaye, CIOMS, 19, avenue Kléber, Paris 16e.)

30–2. Indiana Geological Field Conf., 8th, Clifty Falls State Park, Ind. (C. F. Deiss, Dept. of Geology, Indiana Univ., Bloomington.)

October

1–9. International Food Fair, Cologne, Germany. (International Trade Fair Staff, USDA, Washington 25.)

3–6. Soc. of Exploration Geophysicists, 25th annual, Denver, Colo. (C. Campbell, SEG, 624 S. Cheyenne, Tulsa, Okla.)

3–7. American Inst. of Electrical Engineers, fall general, Chicago, Ill. (N. S. Hibshem, 33 W. 39 St., New York 18.)

4–6. American Meteorological Soc., Stillwater, Okla. (K. C. Spengler, 3 Joy St., Boston 8, Mass.)

4–6. International Assoc. of Milk and Food Sanitarians, Augusta, Ga. (H. L. Thomasson, IAMFS, Box 437, Shelbyville, Ind.)

6–8. Optical Soc. of America, Pittsburgh, Pa. (A. C. Hardy, Room 8-203, Massachusetts Inst. of Technology, Cambridge 39.)

6–8. Soc. of Industrial Designers, 11th annual, Washington, D.C. (S. G. Swing, SID, 48 E. 49th St., New York 17.)

9–13. Electrochemical Soc., Pittsburgh, Pa. (H. B. Linford, 216 W. 102 St., New York 25.)

9–14. American Acad. of Ophthalmology and Otolaryngology, Chicago, Ill. (W. L. Benedict, 100 First Avenue Bldg., Rochester, Minn.)

(*See issue of 15 July for more comprehensive listings.*)

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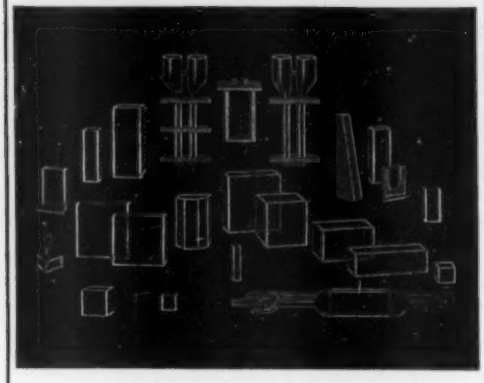

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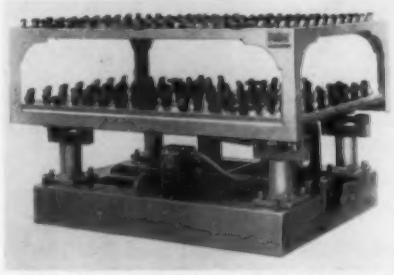

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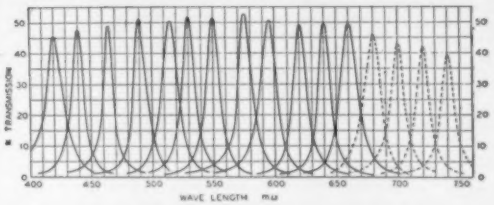

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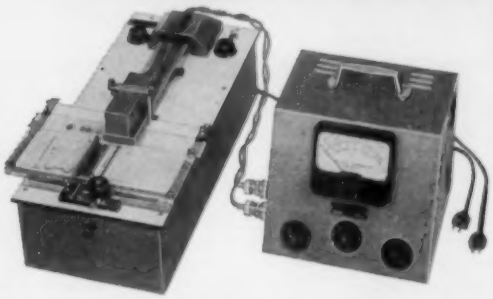

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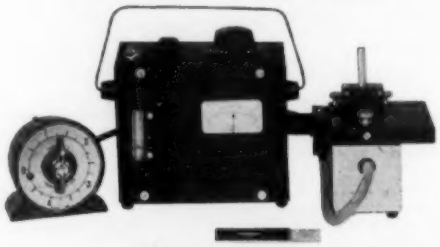

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Biophysicist–Electrophysiologist, Ph.D. or equivalent. Experience with bioelectric potentials and electronics desirable. For university research position. Academic rank and salary to $6,000 according to training and experience. Box 177, SCIENCE. 7/29, 8/5, 12

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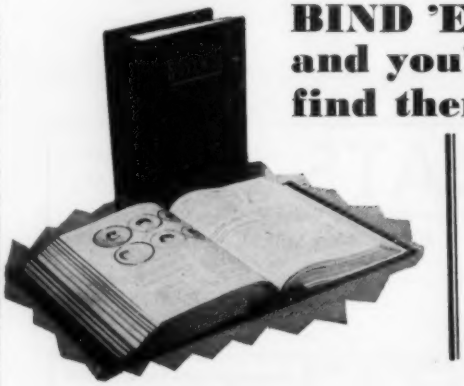

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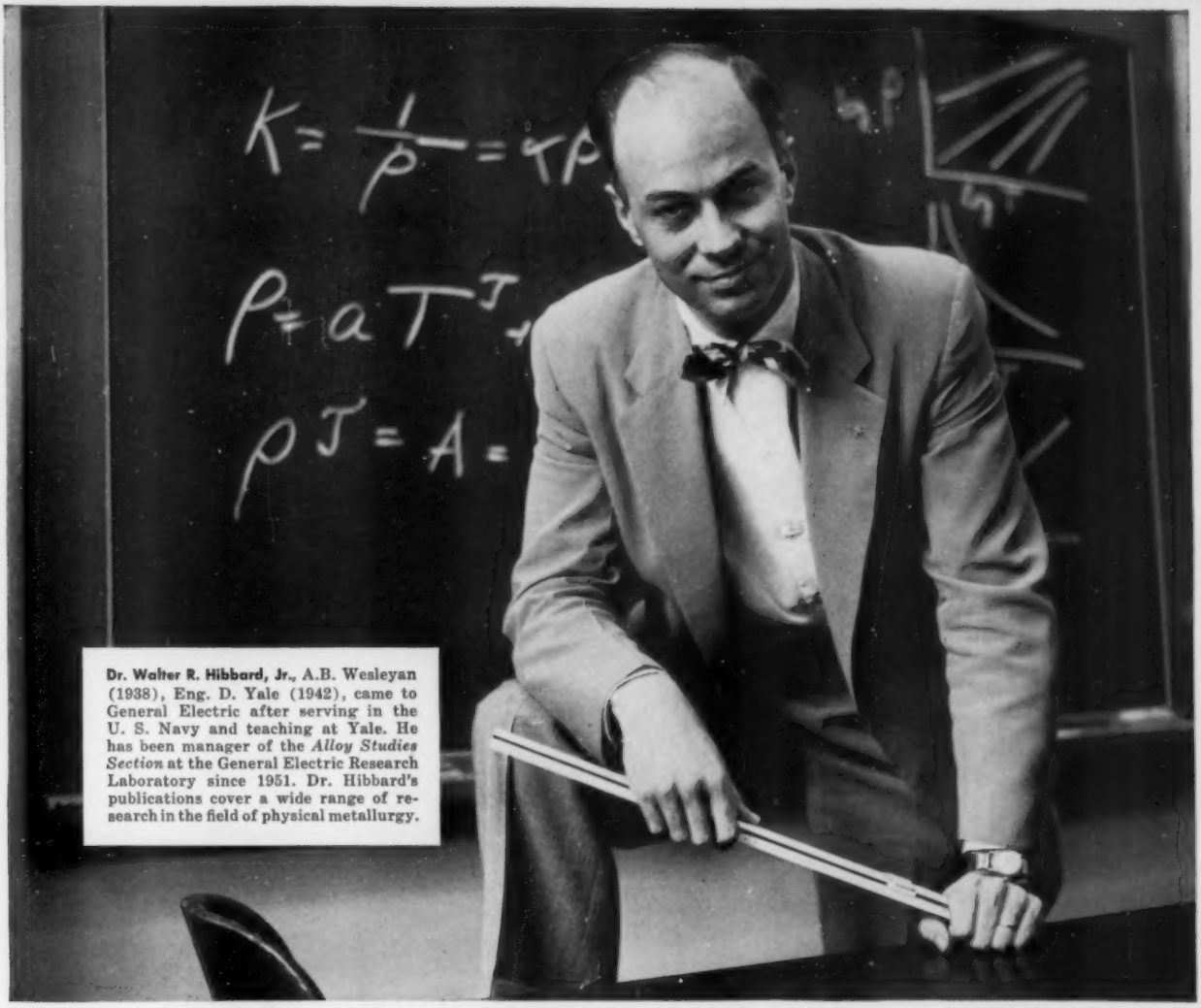

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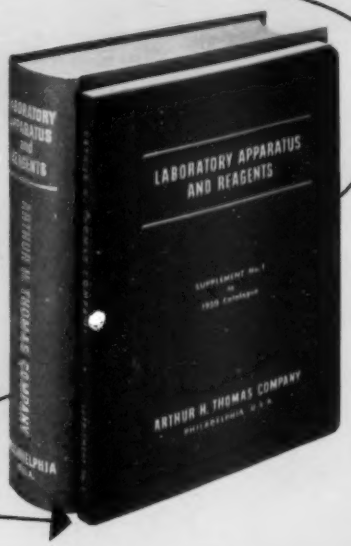

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